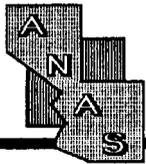


2001

Volume 36

PROCEEDINGS

OF THE



ARIZONA - NEVADA ACADEMY OF SCIENCE

FORTY FIFTH ANNUAL MEETING

April 14, 2001

University of Nevada, Las Vegas

Las Vegas, Nevada

2000-2001 Annual Reports

APRIL 2001

ACKNOWLEDGEMENTS

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**Proceedings
of the
45th Annual Meeting
of the**

ARIZONA-NEVADA ACADEMY OF SCIENCES

**April 14, 2001
University of Nevada
Las Vegas, Nevada**

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ABBREVIATED SCHEDULE AND ACTIVITY LOCATIONS

Friday, April 13

- 5:00 - 6:00 PM** Board Meeting, Koch Auditorium, Room A-108,
Classroom Building Complex (CBC) UNLV
- 6:00 - 6:30 PM** Registration, Koch Auditorium, Room A-108, Classroom
Building Complex (CBC)

Saturday, April 14

All section meetings on Saturday, April 14 will take place on the campus of UNLV, Classroom Building Complex (CBC)

- 7:00 - 8:00** Registration: building labeled Koch Auditorium
- 8:00 - 10:00** Paper Sessions (See Section Schedules)
- 10:00 - 10:30** Coffee Break in Lobby
Poster Session in Lobby
- 10:30 - 11:30** Paper Sessions (See Section Schedules)
- 11:40 - 1:40** Annual Academy Awards Luncheon, Tam Alumni Center, Grand Hall
- 1:40 - 3:00** Paper Sessions (See Section Schedules)
- 3:00 - 3:30** Coffee Break in Lobby
- 3:30 - 5:30** Paper Sessions (See Section Schedules)

A map of the University of Nevada, Las Vegas is located at the end of the Proceedings

SUMMARY OF SECTION MEETINGS
Classroom Building Complex (CBC) - Building C

Section	Session	Time	Room
Anthropology	I	9:00	C-212
Biology	I	8:00	C-218
	II	1:45	C-218
Chemistry	I	8:30	C-213
	II	1:45	C-213
Conservation	I	8:00	C-216
Geology	I	9:00	C-230
	II	2:00	C-230
Hydrology	I	8:00	C-222
	II	1:40	C-222
Poster Session		10:00	LOBBY
Science Education	I	8:00	C-224

* Indicates a paper to be considered for the Best Student Paper Award or Best Student Poster Award

ANTHROPOLOGY SECTION

SESSION I: 9:00

ROOM: C - 212

Chairperson: Bill White

9:00 - 9:15 THE MONUMENTS OF LAS VEGAS: APPROPRIATION AND RECONTEX-TUALIZATION OF CULTURAL ARCHETYPES.

Blaine V. Donaldson (University of Nevada, Las Vegas, Las Vegas, Nevada)

Social scientists have explored the topic of rapid culture change and the creation of cultural worlds. Symbols and icons have been a primary medium through which cultures have communicated syncretic worldviews in response to the changing conditions of human existence. While many contemporary scholars posit that the recent proliferation of built, themed environments constitute the decontextualization and simulation of preexisting architectural forms, I will present data supporting the proposition that these changes in material culture represent ancient global trends through time that are better understood in terms of appropriation and recontextualization of cultural signs. Las Vegas as the world's preeminent themed venue will be examined in the context of global capitalism, and contemporary cultural conceptions of the sacred and profane.

9:15 - 9:30 THE TACTICS AND STRATEGY OF BARGAINING IN THE ESTABLISHMENT OF TRADING PARTNERSHIPS IN A GUATEMALAN MARKETPLACE

John Swetnam (University of Nevada, Las Vegas, Las Vegas, Nevada)

Bargaining has often been treated as an anti-social form of speech, a mode of interaction designed to maximize the interests of the speaker at the expense of his or her partner in the interaction. Sahlins even equates bargaining with theft. Observation of bargaining in a bi-ethnic Guatemalan marketplace, in contrast, reveals a subtle interplay of self-interest and sociability. Bargaining is a public drama in which partners exchange conventional messages as they assess the other's intentions, both in the immediate transaction and the longer term. Depending on the way in which individuals play this stylized game, the result may be either the establishment of long term trading partnerships or brief, agonistic interactions. The errors in bargaining made by non-Guatemalan tourists illustrate the extent of local knowledge needed to function successfully in bargaining transactions

9:30 - 9:45 GRAMMATICAL CHANGE AND BROADCAST SPEECH

George Urioste(University of Nevada Las Vegas, Las Vegas, Nevada)

Quechua, the language spoken and generalized by the Inca, is still spoken today by 6 million people in Peru, Bolivia and Ecuador. In Quechua, sentence embedding is accomplished

by a process known as nominalization. In the last decade, extensive radio broadcasting in Quechua has introduced new grammatical features in the language that reflect both a higher level of Spanish influence and a generalization of grammatical techniques that had restricted use in traditional Quechua grammar. This presentation explains and discusses nominalization and the new -CHUS marked embedded sentences.

**9:45 - 10:00 A CLASSIFICATION SYSTEM FOR MODIFIED SANTA CRUZ
BLASTING POWDER CANS ALONG THE SAN PEDRO, LOS ANGELES
& SALT LAKE RAILROAD**

Jeffrey R. Wedding (Harry Reid Center, University of Nevada-Las Vegas)

During the summer of 1999, archaeologists from the Harry Reid Center for Environmental Studies, University of Nevada, Las Vegas, mitigated twelve railroad-related construction camps along the former San Pedro, Los Angeles & Salt Lake Railroad. Findings from the archaeological endeavors include a variety of secondary uses for twenty-five pound blasting powder cans, typically Santa Cruz brand powder cans produced by the California Powder Works. This paper presents descriptions of the modifications identified in the field, and a suggested classification system.

10:00 - 10:30 COFFEE BREAK in LOBBY

10:30 - 10:45 GIS APPLICATION TO DETERMINE PREHISTORIC PATHWAYS

Annette J. Smith (University of Nevada Las Vegas, Las Vegas, Nevada)

Utilization of Eureka Quartzite at the Bowman site in Pahrump Valley, Nevada initiated consideration into where this resource occurs and potential pathways from this prehistoric site to this resource. The application of geographic information systems (GIS) to determine the best pathways provides insight into potential prehistoric trails exposing possible resource procurement data. Eureka Quartzite is located in the northwest portion of the Spring Mountains, east of Pahrump Valley. Prehistoric populations used many resources from these mountains, including pine nuts and large game, in addition to lithic procurement. Knowing they used Eureka Quartzite supports the fact that they must obtain this resource and GIS can provide the best pathways. These pathways can then be surveyed for the presence of specialized camps and scatters. The possibility of Eureka Quartzite cobbles eroding onto the alluvial fans can also be investigated while surveying these pathways. Prehistoric peoples acquiring resources supports the likely discovery of procurement evidence along these potential prehistoric pathways to the known resource of Eureka Quartzite.

**10:45 - 11:00 *USING ARC VIEW GIS FOR THE SPATIAL ANALYSIS OF
ARCHAEOLOGICAL SITES IN PAHRANAGAT VALLEY, NEVADA**

Brock, A.L., UNLV, Las Vegas, Nevada; White, W.G., UNLV Harry Reid Center, Las Vegas, NV; Omdorff, R.L., UNLV, Las Vegas, Nevada

Pahranagat Valley, Nevada and vicinity provides the setting for an interesting and unique style of prehistoric rock art known only to this region. Data collected from 19 archaeological sites exhibiting the Pahranagat rock art style was examined and evaluated to better understand the spatial characteristics between the sites. Arc View GIS was used to access spatial relationships, make predictions as to site placement and purpose, and to develop a model for further analysis. This paper presents the results of the study.

**11:00 - 11:15 ON EVIDENCE OF CONSUMPTION OF THE DESERT TORTOISE BY
PREHISTORIC OCCUPANTS OF THE MOJAVE DESERT AND
SPECULATIONS AS TO THE ORIGINS OF THE CROCKPOT**

Jeffrey R. Wedding (Harry Reid Center, University of Nevada-Las Vegas) and Alex L. Heindl (Harry Reid Center, University of Nevada-Las Vegas)

Although Great Basin and Southwestern archaeologists generally acknowledge that prehistoric peoples consumed desert tortoises (*Gopherus agassizii*), the literature is largely devoid of hard evidence substantiating this practice. Recent excavations at several prehistoric rockshelters in Clark County, Nevada have revealed clues in collected *Gopherus* bone fragments. The bones occur in concentrations beyond those reasonably attributable to assembly by non-human agents and bear unnatural breakage patterns, cut-marks and evidence of burning. Subsequently, the authors conducted experiments on salvaged desert tortoise carcasses in attempts to duplicate certain breakage patterns observed in the artifact collection, deemed as evidence of butchery for probable consumption by former residents of the excavated sites

**11:30 - 1:40 ANNUAL ACADEMY AWARDS LUNCHEON AND BUSINESS
MEETING – Tam Alumni Center, Grand Hall**

BIOLOGY SECTION

SESSION I 8:00

ROOM: C - 218

Chairperson: Stephen Shuster

8:00 - 8:15 THE RELATIONSHIP BETWEEN THE WHITE RHINOCEROS AND THE AFRICAN ELEPHANT IN A SWAZILAND GAME RESERVE.

Lori Brown (Northern Arizona University, Flagstaff, Arizona)

The relationship between orphaned, bull elephants and the white rhinoceros was studied at the Mkhaya Game Reserve in Swaziland, Africa. The bull elephants were all orphaned at an early age as a result of the Kruger National Park culling program. The bulls grow up with no role model and do not know how to behave when they reach the first musth period. Upon arrival of the musth period, the bull elephants become extremely aggressive. One of the side effects of the aggression is the killing of the white rhinoceros. The purpose of the study was to understand the causes of the white rhinoceros killings and to develop a method of solving the problem. It was found that the inability to control heightened testosterone levels was the main factor in causing the aggressive behavior towards the rhinos. It was decided to bring in older, more mature bulls from other wildlife parks into Mkhaya Game Reserve in order to teach the young bulls proper musth period behavior. It was concluded that human actions were responsible for causing the increased aggression of the elephants and, therefore, the deaths of an endangered species.

8:15 - 8:30 FAT-CELL SPECIFICATION BASED ON THE REGULATION OF THE *DROSOPHILA MELANOGASTER* GENE, *SERPENT*

Jennell M. Miller and Deborah K. Hoshizaki

A universal problem in the development of all multi-cellular organisms is programming a generic precursor cell to become a specific cell type through determination. We have investigated, in *Drosophila*, the regulation of the fat-cell determining gene *serpent* (*srp*) by early expressed patterning cues. The fat body is composed of three domains resulting from a convergence of fat-cell clusters that originate in spatially distinct regions of the mesoderm. Regardless of origin, all fat cells depend on *srp*'s action for normal development. Because the clusters in each domain are subject to distinct sets of patterning information, *srp* must interpret and integrate the differing cues for correct spatial activation. We have focused on one domain, the dorsal fat cell (DFC) cluster, and have identified some of the patterning cues that restrict *srp* expression to this region. We propose that the homeotic gene *Abdominal B* and the Nk-homeobox gene *tinman* provide such patterning cues. We shall present a paradigm to explain the molecular processes of cell specification based on the activation of *srp*.

**8:30 - 8:45 BIOCHEMICAL PATHWAYS INVOLVED IN THE UPKEEP OF THE
DROSOPHILA FAT BODY**

Dana L. Schauer-McLaughlin and Deborah K. Hoshizaki (University of Nevada, Las Vegas)

The *Drosophila* fat body is involved in intermediate metabolism and the innate immune response. All larval tissues, including the fat body, grow by an increase in cell size rather than cell division. During metamorphosis larval tissues undergo histolysis; the fat body is unusual because it does not undergo this process until after eclosion (emergence of the adult). We are currently investigating two mutants, *mothers against dpp* (*Mad*) and *glass bottom boat* (*gbb*), that exhibit little or no fat during the final stages of larval development.

Mad is part of the *dpp* signaling pathway. Both Gbb and Dpp have been identified as bone morphogenic proteins (BMP's). BMP's act as signaling proteins during various developmental processes in many organisms, including humans. We suspect that Gbb might be the BMP involved in the signaling pathway for the upkeep and the control of histolysis of the fat body. Because *dpp* mutants do not exhibit the fatless phenotype we believe that *Mad* might also be involved in the *gbb* signaling pathway. Experiments to further characterize *Mad* and *gbb* mutants and their epistatic interactions are underway.

**8:45 - 9:00 * THE FREQUENCY OF MULTIPLE INSEMINATION IN A NATURAL
POPULATION OF MARINE ISOPODS**

Saundra J. Embry and Stephen M. Shuster (Northern Arizona University, Flagstaff, AZ).

Multiple mating by females can significantly influence the opportunity for sexual selection, I_{mates} . Depending on the degree to which sperm competition occurs, multiple mating by females may enhance or decrease the variance in offspring numbers among males. Because the intensity of sperm competition is difficult to determine from observations of mating alone, it is necessary to document the frequency and circumstances in which multiple paternity occurs. In *Paracerceis sculpta*, a Gulf of California isopod, males and females breed within the spongocoels of intertidal sponges. Breeding aggregations usually consist of one \square -male and one or more females. However, larger aggregations are often invaded by female mimics (\square -males) and/or by sneakers (\square -males). To investigate the frequency of multiple mating within single male and multiple male breeding aggregations, we genotyped, at 7 allozyme loci, all adults from natural aggregations collected over a 2 year period (1987-88). We also genotyped 20-50 progeny from each female. We found no cases of multiple insemination in spongocoels defended by a single \square -male. We also found no evidence of multiple insemination in spongocoels containing more than one male with only one female. In aggregations containing multiple females and multiple males, mixed broods were common, and fertilization success by the resident \square -male decreased as the success of satellite males increased. These results suggest that the relative fitnesses of \square -, \square - and \square -males in this species depend on breeding aggregation size and the frequency of each male type within spongocoels.

9:00 - 9:15 *THE EFFECTS OF JUVENILE ENVIRONMENT, FEMALE REPRODUCTIVE CONDITION AND SATELLITE MALES ON BREEDING SITE SELECTION IN A MARINE ISOPOD, *PARACERCEIS SCULPTA* (HOLMES).

Kimberly E. Garcia and Stephen M. Shuster (Northern Arizona University, Flagstaff, AZ)

Animals must locate suitable breeding sites as well as suitable mates to successfully reproduce. The conditions individuals experience during development, their physiological state when mating opportunities arise, and the types of individuals present when reproduction is imminent, may strongly influence individual reproductive success. We investigated three aspects of breeding site preference in *P. sculpta* using field-collected and laboratory-reared individuals. We found there was no effect of juvenile environment on the responses of □-males to artificial sponges. Lab-reared and field-collected □-males showed no difference in their tendency to colonize. Female reproductive condition significantly influenced female responses to □-males in sponges. Females with mature ovaries showed the strongest tendency to pair with □-males; females with little ovarian development did not enter sponges. Females showed no preference for breeding aggregations with or without satellite (□-) males. These results confirm the value of behavioral experiments using lab-reared individuals in this species and suggest that the physiological state of females strongly influences their responses to males.

9:15 - 9:30 * THE INHERITANCE OF *RETICULATED (RET)* IN *PARACERCEIS SCULPTA* AND THE SIGNIFICANCE OF VARIATION IN CUTICULAR PIGMENTATION IN THE ISOPOD CRUSTACEA.

D. Grossblat and S. Shuster (Northern Arizona University, Flagstaff, AZ).

Cuticular pigmentation is highly variable in *Paracerceis sculpta*, a Gulf of California isopod. Individuals exhibiting the distinctive pattern we call *Ret* (*Reticulated*) have dorsal surfaces that resemble the pelt of a giraffe; that is, the dorsum is covered with brown spots separated by a honeycomb pattern of lighter pigment. Over an 8-year period, *Ret* represented 0.5% of all field-collected individuals (N=9,536). The frequencies of this marker in males and in females were proportional to the population frequencies of each sex ($N_{females}/N_{males}=1.85$; $G=0.6$, $P>.5$). In the laboratory, marked and unmarked parents were crossed in all possible combinations ($N_{crosses}=9$, $N_{progeny}=334$). Ratios of marked and unmarked progeny conformed to the expectations of Mendelian inheritance. Adult expression of *Ret* also conformed to Mendelian expectations ($N_{adults}=121$), indicating that this marker is controlled by a dominant allele at an autosomal locus. In nature, this marker is rare compared to several other cuticular markers described in this species. We discuss possible selective contexts in which cuticular markers may persist in intertidal isopods.

9:30 - 9:45 * SEX CHANGE AND CANNIBALISM IN POPULATIONS OF A COMMENSAL POLYCHAETE

Steven A. Vuturo and Stephen M. Shuster (Northern Arizona University, Flagstaff, AZ)

Most polychaetes are known to be gonochoristic. Hermaphroditism appears to have arisen independently in several families. We have shown that *Ophiodromus pugettensis*, a

hesionid commensal of sea stars in California, is a simultaneous hermaphrodite with a protandric phase. To examine the relationship between sex change and body size in the Sea of Cortez populations, we sampled worms from four geographically disjunct populations inhabiting four species of sea stars. We found differences in the size of worms and their distribution among host species in the Sea of Cortez. Worms on some host species showed a positive relationship between body size and sexual condition while others do not. Density of worms on sea stars predicted sexual condition on some host species but not in others. We observed cannibalism in the Sea of Cortez populations that has not been observed in California populations. This behavior may be related to observed differences in damage to individuals and the differences in density per host between cannibalistic and non-cannibalistic populations. We examined the appearance of hermaphroditism in *O. pugettensis* in the context of two theoretical models. Our observations suggest that sex change is related not only to body size but is also influenced by the density of worms per star and the sex ratio. Distinct reproductive strategies among worms inhabiting different host species suggests that worms associating with particular hosts may be genetically distinct.

9:45 - 10:00 * THE DISTRIBUTION AND ABUNDANCE OF MUD SHRIMP IN A GULF OF CALIFORNIA ESTERO.

A. Agosta, E. Burke, S. J. Embry, K. E. Garcia, M. Kelly, R. Ketner, S. A. Vuturo, H. C. Wildey, and S. M. Shuster (Northern Arizona University, Flagstaff, AZ)

Mud shrimp (Decapoda: Thalassinidea) are among the most abundant infaunal animals inhabiting estuaries and mud flats in temperate and tropical waters. We examined the vertical and horizontal distributions of the mud shrimp, *Neotrypaea uncinata* and *Upogebia pugettensis* in two locations within Estero Morua, near Puerto Peñasco, Sonora, México. We collected substrate cores every meter along 30 meter transects using a 90 x 10cm PCV tube. Two transects were taken from each of two study sites, located at the estero mouth and at its interior. In each core, we recorded the depth, sex, carapace length, dominant chela, reproductive condition, and species of each mud shrimp found. The number of individuals found between sites differed significantly ($G=17.6$, $p<.001$). Shrimp were over-dispersed on a horizontal scale within one transect from each location (runs test; $p<0.05$). We identified four reproductive classes of animals: juvenile, male, female, and gravid female. Carapace length among these classes differed significantly, with males and gravid females larger than non-gravid female and juveniles ($F[3,137]=14.7$, $p<.0001$). Increases in carapace length accurately predicted female reproductive condition using logistic regression ($N=72$, $p=.0017$). Mud shrimp showed significant stratification within the substrate by sex and reproductive condition ($F[3,137]=20.8$, $p<.0001$). A post-hoc test revealed that gravid females were significantly deeper within the substrate than all other classes. These results suggest that the distribution and abundance of *N. uncinata* vary on vertical, horizontal, and geographic scales in their natural habitat.

10:00 - 10:30 COFFEE BREAK in LOBBY

10:30 - 10:45 *THE IDENTIFICATION OF THE MARINE BACTERIA COLONIZING THE HEPATOPANCREAS OF THE FIDDLER CRAB SPECIES *UCA VOCANS* AND *UCA COARCTATA*

Rene Roberts (Northern Arizona University, Flagstaff, Arizona)

Little is known about the nature of bacteria associated with the gut of marine organisms, especially marine crustacea. This paper identifies and compares the bacteria isolated from the hepatopancreas of two fiddler crab species, *Uca vocans* and *Uca coarctata*, collected from a marine and estuarine environment. The hepatopancreas of both fiddler crab species was predominantly colonized by the genus *Vibrio*. *Pseudomonas*, *Enterobacteriaceae*, *Photobacterium*, and *Aeromonas* were also present in both fiddler crab species. However, *Cytophaga*, *Flavobacterium*, and *Pseudoalteromonas* were present only in *Uca vocans*, whereas the genus *Plesiomonas* was present only in *Uca coarctata*.

10:45 - 11:00 THE MEAN CROWDING AND SEX RATIO OF A NORTHERN GULF OF CALIFORNIA MUD SHRIMP (THALLASSINIDEA:DECAPODA)

Herbert C. Wildey and Stephen M. Shuster, Northern Arizona University, Flagstaff, AZ

Thalassinidean shrimp (Decapoda: Crustacea) are abundant burrowing organisms in mud flat and estuarine habitats. Very little is known about mating behavior or reproduction in mud shrimp, however, they are known to exhibit sexual dimorphism, with males possessing larger dominant chela than females. It is widely held that the enlarged chelae of males are used in agonistic interactions, presumably for access to females and during mating attempts, although this behavior has never been observed. We collected the mud shrimp *Neotrypaea uncinata*, once a month for 11 months at Estero Morua in the northern Gulf of California. Shrimp were collected along 30 meter transects coring every meter using a "shrimp gun," a 90 x 10 cm PVC tube. For each of these months we calculated R , the sex ratio within cores, m^* , mean crowding of all shrimp and females, and P , the patchiness of all shrimp and females. We found no significant positive relationship between the density of mud shrimp and R , suggesting that males were not defending harems. Mean crowding and patchiness of females was low, indicating that females were overdispersed in space. Females in this population were gravid only once all year, suggesting that the temporal crowding of females at the time of mating is probably high. Despite extreme sexual dimorphism in this species, all of our measurements pointed to a low opportunity for sexual selection. These results suggest that if mating in this population occurs over an extremely brief period of time, spatial clumping of females must increase considerably when mating occurs. Our results also suggest that alternative explanations may be required to explain sexual dimorphism in mud shrimp.

11:00 - 11:15 THE EFFECTS OF FOOD AVAILABILITY ON MOLTING RATE AND INTERMOLT SIZE IN *PARACERCEIS SCULPTA* HOLMES (CRUSTACEA: ISOPODA).

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

Three discrete male morphotypes coexist in *P. sculpta*. Phenotypic differences among males are caused by a major gene (Ams =*alternative mating strategy*), whose inheritance is Mendelian and whose alleles exhibit directional dominance ($Ams^{\square} > Ams^{\square} > Ams^{\square}$). To determine

the effect of food availability on molting rate and intermolt body size, we reared individuals to maturity from *Ams*[□] *Ams*[□] and *Ams*[□] *Ams*[□] lineages under high and low treatments of food availability (food provided every 2 days; food provided every 4 days). Alpha-males were larger and molted more than females, who molted more than □-males before reaching maturity. Feeding treatment significantly affected adult body length and days to maturity, but had no effect on molt number. Starved individuals were smaller and took longer to mature than well-fed individuals. Within treatments, we found significant family and sex effects on intermolt body length, but no significant effects of these factors on molting rate. These results suggest that molt number in this species is constant and that nutrient deficits limit intermolt growth and delay sexual maturation.

11:15 - 11:30 THERMOSPHEROMA BOWMANI, A NEW SPECIES OF SPHEROMATID ISOPOD FROM CASAS GRANDES, CHIHUAHUA, MEXICO.

Jennifer K. Learned and Stephen M. Shuster (Northern Arizona University, Flagstaff, AZ)

Isopods of the genus *Thermosphaeroma* inhabit thermal springs in Texas, New Mexico, and Mexico. In this paper I describe a new species, bringing the number of described species to eight. *Thermosphaeroma bowmani* n.sp. is endemic to a thermal spring in Casas Grandes, Chihuahua, Mexico. It can be differentiated from other members of the genus genetically and by uropod characteristics. I include in this description an expanded key to the genus, a comparison of sexual dimorphism among species, and remarks on history as well as future directions.

11:30 - 1:40 ANNUAL ACADEMY AWARDS LUNCHEON AND BUSINESS MEETING - Tam Alumni Center, Grand Hall

SESSION II 1:45

ROOM: C - 218

Chairperson: Stephen Shuster

1:45 - 2:00 CAN OVIGEROUS CRAYFISH (*PROCAMBARUS CLARKII*) CONTROL THEIR BROODING ENVIRONMENT THROUGH BEHAVIOR?

Aaron Payette and Iain McGaw (University of Nevada Las Vegas, Las Vegas, Nevada)

The red swamp crayfish, *Procambarus clarkii*, is a widespread and invasive species in North America. It is a tertiary burrower spending most of the year in a permanent body of water, but retreats to burrows when water levels drop and temperatures increase. Adverse temperatures force decapod crustaceans to alter cardiovascular, respiratory and acid-base functions, which is physiologically costly. This is detrimental to ovigerous females who brood at strict environmental conditions, and adverse temperatures may disrupt the development of eggs. The aim of the present study is to investigate the thermal tolerance of this species, and to determine if they exhibit behavioral mechanisms that allow them to avoid exposure to adverse conditions. Thermal preferences of males, females and ovigerous females were determined in a temperature gradient of 12 to 31°C. Thermal tolerance experiments were conducted in an artificial burrow

chamber, where water was heated or cooled until the crayfish exited the water. The mean temperature preferences for males, females, and ovigerous females were 24.0, 22.6, and 18.7°C respectively; while mean water exit temperatures in the artificial burrow were 30.4, 31.3, and 28.6°C respectively. The results show that there is a difference in the thermal preferences of ovigerous females, compared with males and non-ovigerous females. This suggests that ovigerous females may use behavioral mechanisms to control the physical environment in which eggs are brooded.

2:00 - 2:15 IMPACTS OF HABITAT COMPLEXITY ON PHYSIOLOGY: PURPLE SHORE CRABS TOLERATE OSMOTIC STRESS FOR SHELTER.

Iain J. McGaw (University of Nevada - Las Vegas, Nevada)

Purple shore crabs, *Hemigrapsus nudus* (Crustacea: Decapoda), can survive indefinitely in salinities of 8ppt, but also tolerate short-term exposure to salinities as low as 2ppt. In the laboratory their salinity preference range, determined from choice chamber experiments, is 22-32ppt and they can discriminate between pairs of salinities separated by a difference of 2ppt. These crabs show a strong positive thigmotaxis and a weak negative phototaxis and tend to choose environments with available shelter. The presence of shelter significantly alters the behavior of this species. When shelter is available the salinity preference range is 10-32ppt. Even in salinities below this preference range, the presence of shelter prolongs the time spent in the lower test salinities. This change in behavior has implications on the physiology: the hemolymph osmolality falls to lower levels when crabs remain in low salinity under shelters. In the field, *H. nudus* is found in creeks with salinities close to freshwater and they may remain in this salinity for up to eleven hours, if there are rocks to shelter under. An increase in habitat complexity increases the number of crabs that are found within the creek. These crabs in the low salinity environment have a lower hemolymph osmolality than crabs on the nearby open shore. In *H. nudus* the behavioral selection of a shelter appears to outweigh the physiological costs associated with osmotic regulation of the body fluids. Therefore, the distribution of *H. nudus* in estuaries may depend more on the availability of suitable habitats rather than the salinity tolerance of this species.

2:15 - 2:30 CHARACTERIZATION OF A DROSOPHILA TUMOR-CAUSING MUTATION, TU-65

Placida Martinez, Elisabeth Kang and Deborah K. Hoshizaki (University of Nevada at Las Vegas, LV, NV)

Drosophila melanogaster (fruit fly) has served as a model system for many biological processes, including the immune system. Immune malfunctions render *Drosophila* capable of developing two types of tumors: neoplasms and melanotic pseudo-tumors. We have recently identified a mutation, *tu-65*, that causes melanotic pseudo-tumors. These pseudo-tumors are characterized as black dense masses found in the 3rd instar larvae. Although melanotic pseudo-tumors have been previously described, most melanotic pseudo-tumors are benign and/or have incomplete penetrance. *tu-65* is unusual in that it is a lethal mutation and the penetrance of the melanotic pseudo-tumor phenotype is nearly 100%. We genetically mapped this mutation to the *rough* (3-0.0) *hairy* (3-26.5) interval at position 3-15.4. By cytogenetic mapping, using deficiency mutations, we further located *tu-65* to the cytological interval 64E-65A. To clone the *tu-65* gene, we are carrying out left-right mapping experiments using P-element insertions that

have been used as sequence tags in the Berkeley Drosophila Genome Project. The results of these experiments will help to correlate the *tu-65* gene to DNA sequences and transcription units identified in the genome project, and thus facilitate the cloning of this gene.

2:30 - 2:45 IT AIN'T NECESSARILY SO -- REFLECTIONS ON THE VALUE OF SKEPTICISM APPLIED TO THE "GRAY" SCIENTIFIC LITERATURE

Alex L. Heindl (University of Nevada, Las Vegas)

Discussion of a facetious article about rattlesnakes in Nevada, unwittingly cataloged alongside solid references in the *Zoological Record*, is presented as a reminder of the value of peer review and the importance of maintaining skepticism when using the "scientific" literature.

2:45 - 3:00 DISTRIBUTION OF THE WESTERN DIAMONDBACK RATTLESNAKE (*CROTALUS ATROX*) IN NEVADA, AND DISCUSSION OF FACTORS POSSIBLY CONTRIBUTING TO THE OBSERVED OCCUPATION PATTERN

Alex L. Heindl (University of Nevada, Las Vegas)

Western diamondback rattlesnakes (*Crotalus atrox*) reach the northwest extent of their range in southern Clark County, Nevada and adjacent northern Mohave County, Arizona. Research conducted in Clark County, Nevada between October, 1995 and July, 1998 seeks to (1) redefine *C. atrox*' Nevada distribution and (2) illuminate some possible reasons why the species does not range farther north within the State.

The primary geographic range of *C. atrox* in Nevada is the complex of alluvial fans falling south from the Newberry Mountains in extreme southern Clark County. Small, possibly isolated or even relict diamondback populations also occupy some of the larger drainages within the Newberrys. Fossil evidence shows that during the late Pleistocene and early Holocene epochs *C. atrox* ranged farther north in Nevada than at present. Diamondbacks now occupying Nevada occur in what is probably marginally suitable habitat in an area of mixed Sonoran Desert and Mojave Desert climatic influences.

3:00 - 3:30 COFFEE BREAK in LOBBY

3:30 - 3:45 TAMARIX APHYLLA: A POTENTIAL INVADER OF THE DESERT SOUTHWEST.

P. Barnes and L. Walker (University of Nevada, Las Vegas, Las Vegas, Nevada)

In the Southwestern United States, the athel pine (*Tamarix aphylla*) has been presumed to be sterile and therefore not as likely to spread as its cogener, *Tamarix ramosissima*. However, at the Lake Mead National Recreation Area, populations of the tree have spread beyond their original boundaries, forming monospecific stands, creating a threat to native flora and fauna. Trees at three sites along the western shore of Lake Mead were observed during the fruiting season and seeds were collected. We examined the germinability of *T. aphylla* seeds under laboratory conditions and found that the trees in this area do produce seeds capable of

germination. Some trees that we sampled produced no viable seeds but others had germination rates of eighty-eight percent. With a fruiting season that lasts from September to January, the *T. aphylla* at Lake Mead produce millions of viable seeds each year. The possibility of sexual reproduction of this exotic, combined with rapid vegetative reproduction, makes *T. aphylla* an invasive threat along the shores of Lake Mead and other mesic areas in the desert Southwest.

3:45 - 4:00 IDENTIFICATION AND ISOLATION OF ORGANISMS CAUSING TASTE AND ODOR PROBLEMS IN SURFACE WATER SUPPLIES OF METROPOLITAN PHOENIX, ARIZONA

Thomas A. Dempster, David Lowry and Milton R. Sommerfeld (Arizona State University, Tempe, Arizona)

Monthly baseline monitoring of 18 permanent surface water sites, including lakes, canals and treatment facilities, commenced in August 1999. Physical and chemical water quality data were collected to develop an understanding of the system dynamics. In addition, phytoplankton and periphyton samples were collected for the purpose of algal identification, enumeration and isolation. Over 120 species have been identified since August 1999. Algal counts have ranged from <100 organisms/ml to >5000 organisms/ml. Algal abundance by division appears to exhibit typical trends with diatoms being dominant in cooler months and cyanophytes and chlorophytes exhibiting marked increases in abundance during warmer months. Chlorophyll a analysis was also shown to be a reliable indicator of relative algal biomass. Systematic algal isolation efforts were undertaken in an attempt to identify algal species (or strains) responsible for the production of two well-documented algal metabolites that are responsible for earthy/musty tastes and odors: 2-methylisoborneol (MIB) and (E)-1,10-dimethyl-9-decanol (geosmin). Isolates were grown on both nutrient enriched agar and synthetic liquid media to increase the probability of detecting earthy/musty odors from "culprit" organisms in culture. To date, over 800 isolates have been initially evaluated for the production of MIB and geosmin. Suspect organisms were subjected to gas chromatography/mass spectroscopy (GC/MS) analysis to confirm MIB and/or geosmin production. MIB or geosmin production has been confirmed in nine organisms isolated from seven different surface water sites. More than 40 additional presumptive MIB and/or geosmin-producing "culprit" organisms will also be evaluated using GC/MS analysis.

4:00 - 4:15 AN OVERVIEW OF MICROORGANISM-RELATED TASTE AND ODOR PROBLEMS IN SURFACE WATER SUPPLIES OF METROPOLITAN PHOENIX, ARIZONA

Thomas A. Dempster, Milton R. Sommerfeld, Larry Baker, Qiang Hu, David Lowry, My-Linh Nguyen, Paul Westerhoff, and Darlene Bruce (Arizona State University, Tempe, Arizona)

Drinking water-related consumer complaints have increased substantially in most cities throughout the Metropolitan Phoenix area over the past decade. Earthy/musty tastes and odors in drinking water are the most common descriptors used by dissatisfied consumers. The algal metabolites 2-methylisoborneol (MIB) and (E)-1,10-dimethyl-9-decanol (geosmin) are most often implicated as the compounds responsible for the unpleasant earthy/musty tastes and odors. Numerous microorganisms have previously been reported as MIB and/or geosmin producers. However, no evidence exists to date that the same "culprit" species are responsible for MIB and geosmin production in different geographic locations. In an attempt to identify causal organisms and develop optimum treatment methods specifically suited for the Phoenix area surface waters,

Arizona State University is involved in a three-year cooperative comprehensive research project with the City of Phoenix, the Salt River Project (SRP) and the Central Arizona Project (CAP). Project objectives include developing a multi-barrier approach to control or mitigate taste and odor episodes. Both proactive and responsive measures have been initiated. Proactive measures include procedures to reduce growth of confirmed taste and odor-producing algae through early detection, whereas responsive measures include innovative water treatment techniques to reduce taste and odor compounds to levels below threshold when proactive steps are unsuccessful.

4:15 - 4:30 DOSES FROM THE TRANSPORTATION OF RADIOACTIVE WASTE

Mariaz Davis, Anthony E. Hechanova, and Gary S. Cerefice (University of Nevada, Las Vegas)

Doses are calculated for five transportation scenarios involving radioactive waste truck shipments, using the scenarios specified by the Nuclear Waste Advisory Board of the Town Board of Pahrump. These scenarios are based on actual circumstances expected to occur in the small community about 25 miles from the Nevada Test Site where low-level radioactive waste has been trucked from other U.S. Department of Energy sites since 1978. Students and researchers from the University of Nevada, Las Vegas, have developed analytical models to perform calculations to examine how large a radiation dose someone would receive due to the transportation of radioactive waste under the following scenarios: (1) standing next to a stationary truck for 1 hour, (2) driving behind a truck for 1 hour, (3) pulled up next to a truck at a stoplight, and (4) standing near a road where trucks are going past. Using the U.S. Department of Transportation limits on dose rate, it is estimated that the exposed individual would receive small doses (less than 10 mrem) under these scenarios. Doses of less than 1 mrem are calculated for a shipment with a dose rates equal to the highest observed from a low-level radioactive waste shipment to the Nevada Test Site to date. The doses to a worker in a building where trucks stop, such as a gas station, are also examined. This work was funded by a DOE grant # DE FC08 00NV13813.

4:30 - 4:45 POTENTIAL USE OF BONYTAIL (*GILA ELEGANS*) TO ENHANCE SURVIVAL OF RAZORBACK SUCKERS IN REARING PONDS

Nathan Lenon (US Bureau of Reclamation, Boulder City, Nevada), Krystyna Stave and James E. Deacon (University of Nevada, Las Vegas, NV)

This study examined the potential of Bonytail (*Gila elegans*) to enhance survival of young Razorback sucker in rearing ponds by serving as a biological control agent for young stages of Red Swamp Crayfish (*Procambarus clarki*). Crayfish less than 17 mm CPL are able to escape the 1/4 inch mesh traps used to control adult populations. Young Bonytail used in the experimental trials consumed young crayfish ranging in size from 3 mm CPL to 17 mm CPL, so long as the crayfish did not exceed 25 percent of the Bonytail's total length. Consumption of young crayfish by juvenile Bonytail was not reduced in the presence of alternative food sources, but was reduced slightly by the presence of cover. These experimental results suggest that juvenile Bonytail may effectively reduce population sizes of crayfish less than 17 mm CPL in ponds presently used to rear Razorback suckers. If so, integration of rearing programs for these two endangered species could have a synergistic effect.

4:45 - 5:00 SEASONAL CHANGES IN "ANTIFREEZE" EXPRESSION IN MT. CHARLESTON MOSSES

Laura Weiss¹, Lloyd Stark¹, Chris Fritsen² and James Raymond¹ (¹Department of Biological Sciences, University of Nevada, Las Vegas; ²Desert Research Institute, Reno, Nevada)

Macromolecular compounds that affect the growth of ice crystals were previously identified in mosses from Antarctica and from cold environments in southern Nevada. In this study, we attempted to see if the levels of these compounds increased in Mt. Charleston mosses during the progression from early autumn to early winter under natural conditions. Seven species of mosses were collected from elevations from 1570 m to 2410 m from 30 September to 29 December 2000 at approximately 2-wk intervals. Antifreeze activity was estimated from the ability of homogenates of the mosses to cause pitting on the surface of single ice crystals. Much variation in activity was found during the sampling period, but there was a trend towards increasing activity with time. Some of the variation may have been due to temperature anomalies. High elevation samples tended to have greater activity than lower elevation samples which were presumably exposed to warmer temperatures. One sample (*Bryum* sp.) was incubated in the laboratory at room temperature for 3 weeks after which it was found to have no activity. Six days after the incubator was moved to a cold room (+4°C), the sample showed clear antifreeze activity. These results indicate that several species of mosses in southern Nevada naturally increase production of an antifreeze compound in response to exposure to low temperatures.

CHEMISTRY SECTION

SESSION 1 8:30

ROOM: C - 213

Chairperson: Kathleen Robins

8:30 - 8:45 PENTACOORDINATE BIS(8-HYDROXYQUINALDINE) CARBOXYLATE GALLIUM (III) CHELATES: EFFECT OF HALOGENATION OF THE CARBOXYLATE LIGAND ON ELECTROLUMINESCENCE

Sanjini Nanayakkara, Asanga Padmaperuma, Jeffrey Marshall, Richard Schofield, Danny Fogarty and Linda S. Sapochak*

The photophysical and electroluminescence properties of pentacoordinate bis(8-hydroxyquinaldine) carboxylate gallium (III) chelates have previously been reported. It was shown that the absorption and emission energies of the metal chelates were identical for –OC(O)R, with R = methyl, t-butyl, and phenyl. However, photoluminescence quantum efficiencies were dependent on the monodentate carboxylate ligand, varying from 0.05-0.07 in chloroform solution. When these materials were examined as the emitter layer in identically prepared organic light-emitting devices (OLEDs), the electroluminescence efficiencies scaled with photoluminescence efficiencies, but operating voltages increased with the bulkiness of the monodentate ligand. We have prepared a series of similar pentacoordinate chelates with halogenated carboxylate monodentate ligands (-OC(O)R, with R = CF₃, CH₂F, CHF, CBr₃ and CCl₃). The effect of halogenation of the monodentate ligand on the electroluminescent devices properties will be discussed.

8:45 - 9:00 LYOTROPIC LIQUID CRYSTALLINE AND LIGHT-EMITTING PROPERTIES OF POLY(PYRIDINIUM SALT)S WITH ORGANIC COUNTERION

Ronald A. Burchett, Haesook Han, and Pradip K. Bhowmik (University of Nevada Las Vegas, Las Vegas, NV)

Recently, nitrogen-containing polymers have received an unabated attention in the design and synthesis of electroluminescent polymers. Besides their light-emitting properties, conducting and liquid crystalline properties (lyotropic-solvent induced and thermotropic-heat induced) of suitably designed polymer structures make them attractive materials in many technological applications. A series of poly(pyridinium salt)s containing tosylate ion were prepared by the ring transmutation polymerization reaction of 4,4'-(1,4-phenylene)bis(2,6-diphenylpyrylium) ditosylate with various aromatic diamines in dimethyl sulfoxide. Their polyelectrolyte behavior in organic solvents was studied by viscosity measurements, and their chemical structures were determined by elemental analysis, ¹H and ¹³C NMR spectroscopy. They were characterized for the determination of their lyotropic properties in polar both protic and aprotic solvents by polarizing light microscopy. Their optical properties both in solution and in the solid state were also determined by using UV-vis and fluorescence spectroscopy.

**9:00 - 9:15 GAS TRAPPING IN VAPOR DEPOSITED WATER-ICE FILMS
(90-145 K)**

Brian Raymond, Doug Kober, and Marin Robinson (Northern Arizona University, Flagstaff, AZ)

Water-ice is abundant throughout the solar system. As the ice condenses, it traps gases in its pores. The amount of gas trapped depends, in part, on the phase of the ice (amorphous or crystalline). As the ice warms, as it would in a comet approaching the Sun, amorphous ice rearranges into crystalline ice and some of the trapped gases are released. The purpose of this study was to investigate this process with CO₂ and CH₄. In a high vacuum chamber, a thin film (375 nm) of amorphous (90-110 K) or crystalline (110-145 K) water ice was co-deposited with CO₂ or CH₄ (10:1 gas: water) on a precooled Al substrate. The film was annealed (1K/min) through the phase change (147-153 K) and sublimation of the ice film (162-183 K). The phase change was monitored using grazing-angle Fourier Transform Infrared-Reflection Absorption Spectroscopy, while the gas trapped in the ice was detected using integrated flux to a mass spectrometer. Preliminary results show that both gases were trapped by ice. Significantly more CO₂ was trapped in amorphous ice than in crystalline ice; however, the "excess" was released during the phase change. Hence, the amount of CO₂ released at sublimation was essentially the same for both phases. A similar trend was noted for CH₄, but less CH₄ gas was trapped by the ice.

**9:15 - 9:30 PROBING POLYANILINE/GOLD COMPOSITES USING THIOL
INTERACTIONS**

David W. Hatchett, Rawnica Ruegner, Maxwell Wilson, Lydia McKinstry (University of Nevada, Las Vegas, Las Vegas, NV)

The inherent low selectivity of analytical sensors that use conductive polymer transducer materials has resulted in the limited application of these devices. The electrochemical formation of gold clusters within polyaniline is one possible approach to enhance the selectivity of the polymer by providing discrete reaction sites. The symbiotic relationship between metal clusters and the conductive polymer provides platforms for signal generation. Molecular and atomic recognition is achieved using attached functional groups on the metal clusters (e.g., metal/thiol linkages). In this study the electrochemical characterization of self-assembled monolayers generated from four ferrocene tagged thiols was performed. The data indicates that oxidation and reduction at ferrocene centers results in a measurable current. This suggests that long range interactions are communicated from the ferrocene tagged thiol to the electrode surface via the polymer backbone.

**9:30 - 9:45 ENVIRONMENTAL EFFECT OF USING SALT FOR DE-ICING AS
DETERMINED FROM SOIL CHLORIDE MEASUREMENTS**

William Mason (Northern Arizona University, Flagstaff, AZ)

Soil samples were collected in the median and on the east and west berms of I-17 approximately 25 miles south of Flagstaff, Arizona. Control samples were taken approximately 100 yards east and west of the I-17 sampling site. Chloride content of all samples was measured by ion chromatography. The differences between control and sample sites were taken as a measure of road salt. The median chloride values for the different sampling sites were compared

by Analysis of Variance (ANOVA) statistical procedures to quantify changes to natural soil chloride concentrations.

9:45 - 10:00 SOIL DIGESTION: METHODS AND RECOVERY OF HEAVY METALS IN SOILS COLLECTED IN THE NAVAJO POWER PLANT VICINITY (PAGE, ARIZONA)

Jonathan Regner (Northern Arizona University, Flagstaff, AZ)

Analysis of heavy metals in soil requires a leaching process known as a digestion. Three types of soil digestions are to be discussed; nitric acid and hydrogen peroxide open beaker, mixed acid open beaker, and microwave digestion. Each method will be discussed in detail. Digest recoveries of Lead, Cadmium, Chromium, Vanadium, Iron, and Manganese will be compared and related to each method of digestion. Results of the analysis and an examination of each metal's origin will follow.

10:00 - 10:30 COFFEE BREAK in LOBBY

Chairperson: Stephen Carper

10:30 - 10:45 AN ALTERNATIVE FORM OF THE PCNA-BINDING MOTIF CONSENSUS SEQUENCE

Frank Valle and Ronald K. Gary (University of Nevada, Las Vegas, Las Vegas NV)

There are at least seven distinct proteins involved in DNA metabolism or cell cycle regulation that are known to bind to PCNA. Each contains a PCNA-binding motif of form "Q-x-x-h-x-x-a-a", where Q = glutamine, x = any amino acid, h = hydrophobic, and a = aromatic. RFC (replication factor C) is another protein known to bind to PCNA, but the region or regions of interaction have not yet been mapped to fine detail. Here we report that a short region at the N-terminus of the 140 kD subunit of human RFC binds to PCNA. This region contains the amino acid pattern "M-x-h-x-x-a-a", where M = the initiating methionine. This pattern closely matches the classic PCNA-binding motif consensus, except that the conserved Q is notably absent. We used database searching to identify additional RFC-type motifs for determination of PCNA-binding activity, and report our results for the motif from the structure-specific nuclease Xrn1. This work was supported by a UNLV Undergraduate Research Grant (to FV) and by a Ralph E. Powe Junior Faculty Enhancement Award from Oak Ridge Associated Universities (to RKG).

10:45 - 11:00 HSP27 INHIBITS APOPTOSIS BY BINDING TO CYTOCHROME C

Joe Stafford, Hokunani Keehu, Stephen W. Carper (UNLV Cancer Institute, University of Nevada Las Vegas, NV)

Previous studies in our lab and by others have shown that heat shock protein 27 (hsp27) inhibits apoptosis, which is a programmed cell suicide. To achieve apoptosis, the cell must activate caspases, in a specific sequence (caspase cascade). The activation of the caspase cascade is dependent on the release of cytochrome c from the mitochondria. To determine how hsp27 inhibits apoptosis, several studies were conducted. Following exposure to sodium butyrate, an

inducer of apoptosis, cells that over express hsp27 failed to show activation of caspase 3 or caspase 9. In vitro studies using recombinant caspase 3, and hsp27 showed that hsp27 does not directly inhibit caspase activity, indicating that hsp27 inhibits the activation but not the activity of caspases. To confirm these findings, a caspase activator Granzyme b was added to caspase 3 in the presence to hsp27, which had no effect on Granzyme b activation of caspase 3. Immunoprecipitation experiments show that hsp27 binds to cytochrome c which can prevent it from activating caspase 9 and hence caspase 3. These results indicate that hsp27 is a novel inhibitor of apoptosis.

11:00 - 11:15 OKADAIC ACID INDUCED CELL DEATH IN SCC-25 CELLS

Gabriel Garcia and J. Abiodun Elegbede (University of Nevada, Las Vegas, Las Vegas, NV)

Okadaic acid (OA), a cytotoxic polyether derivative of a C₃₈ fatty acid, was first isolated from marine sponges. OA is an inhibitor of protein phosphatases 1 and 2A and has been shown to be a potent non-phorbol tumor promoter in the mouse skin carcinogenesis model. Recent studies, however, have shown that OA induced apoptosis in a number of cell lines including human bladder, breast, colon and pancreatic tumor cell lines. We studied the effects of OA and its sodium salt (OA-Na) on human, tongue squamous cell carcinoma (SCC-25) cell line. Cells were cultured and exposed to different concentrations of OA and OA-Na for up to 48 hours. The effects of these compounds on cell proliferation were determined using dye exclusion, mitochondrial dehydrogenase and colony formation assays. Both OA and OA-Na elicited kinetic and dose-dependent inhibition of proliferation of the cancer cells. The sodium salt of OA appeared to be more effective at inhibiting proliferation. We found that inhibition of proliferation was as a result of cell death. We propose to confirm if the mode of cell death is via apoptosis and to investigate the mechanism of action of these agents using flow cytometric and molecular biology techniques.

11:15 - 11:30 CYTOCHROME C TOXICITY IN VIVO

Sujay Patel, Aneel Nath, Dr. Stephen W. Carper (UNLV Cancer Institute, University of Nevada, Las Vegas, NV)

Apoptosis is a type of cell death, which has gained much interest due to its involvement in such diseases as AIDS and cancer. Much of the pathway leading to apoptosis is known. For a cell to undergo apoptosis, many proteins, known as caspases, must be sequentially activated in a pathway known as the caspase cascade. One important protein involved in apoptosis is cytochrome c, which activates the caspase cascade. That is, cytochrome c is important for cell death. Apoptosis is important because cells that are toxic to the human body are signaled to die. If this process is somehow inhibited, severe diseases, such as various types of cancer, may result. Heat shock protein 27 (hsp 27) is one molecule, which may prevent cytochrome c from stimulating apoptosis. Many studies have shown that hsp 27 and cytochrome c form a complex, thus preventing apoptosis in vitro, or in a test tube. However, it is not well known whether this actually occurs in vivo, or in the body. To gain more knowledge regarding the complex pathways that lead to cancer, I will report on the interaction between cytochrome c and hsp 27 in vivo, using transfection methods.

11:30 - 1:40 ANNUAL ACADEMY AWARDS LUNCHEON AND BUSINESS MEETING - Tam Alumni Center, Grand Hall

SESSION II 1:45

ROOM: C - 213

Chairperson: Richard Foust

1:45 - 2:00 THE NEUROPEPTIDE SOMATOSTATIN REGULATES BRAIN GLIAL CELL PRODUCTION OF THE CYTOKINE INTERLEUKIN-6

Scott Horrell and Bryan L. Spangelo (Department of Chemistry, UNLV, Las Vegas NV)

Cytokines are mediators of the immune response and have the ability to affect neuroendocrine function and hormone secretion. The cytokines interleukin-1 (IL-1) and interleukin-6 (IL-6) are produced during an immune reaction and cause inflammation of the surrounding tissue. Alzheimer's disease (AD) is a neurodegenerative disorder characterized by well-defined neuropathologic entities. Both IL-1 and IL-6 are present in senile plaques and may cause a self-propagating inflammatory process that contributes to the disease processes of AD.

Somatostatin (SRIF) is a small, inhibitory neuropeptide present throughout the central nervous system (CNS). AD causes the degeneration of somatostatin-containing neurons and a decrease of SRIF in the CNS. Because SRIF is an inhibitory neuropeptide we sought to determine the effects of SRIF on the production of IL-6 in rat C6 glial tumor cells. The release of IL-6 in the C6 cell conditioned media was quantified using the IL-6 dependent 7TD1 hybridoma bioassay.

SRIF significantly reduced the IL-1 stimulation of IL-6 released from C6 glioma cells in vitro. Isoproterenol (IPT) is a drug that mimics the actions of the neurotransmitter norepinephrine. IPT in the presence of IL-1 caused a synergistic stimulation of IL-6 release from C6 glioma cells. In addition, SRIF blocked the IL-1 plus IPT synergistic induction of IL-6 release. An increase of somatostatin in the AD patient brain may result in the reduction of the pathologically high levels of the cytokine IL-6. We suggest that the ability to lower these concentrations maybe therapeutic for AD patients.

2:00 - 2:15 STABILITY OF HSP 27 – CYTOCHROME C COMPLEX

Aditi Singh, Wade Gaal, Dr. Stephen W. Carper, UNLV Cancer Institute, University of Nevada, Las Vegas

Although biomolecular systems are complex and diverse, the structure and recognition are controlled by relatively simple molecular interactions. These interactions are also seen in proteins in the form of hydrogen bonding, hydrophobic interactions, ionic bonding, and steric interactions. The folding and stability of proteins depends on such interactions. One protein that depends on such interactions is heat shock protein 27 (hsp 27). The cell uses heat shock proteins in order to withstand various stressful conditions. Hsp 27 is particularly interesting in that it may play a role in breast cancer, as seen in the high levels present in some tumor cells. One pathway in which hsp 27 may be involved in breast cancer, it interacts with a mitochondrial protein, cytochrome c. Previous studies have shown that cytochrome c can induce programmed cell

death, or apoptosis. This induction of apoptosis is important, because if cells do not die, many complications can result, particularly cancer. Without the induction of apoptosis, cells do not die, which may lead to cancer. I will report on the stability of the hsp 27-cytochrome c complex to better understand the pathways that lead to the inhibition of apoptosis.

2:15 - 2:30 PERILLYL ALCOHOL HAS BOTH CYTOSTATIC AND CYTOTOXIC EFFECTS IN CANCER CELLS

Sanjeewa Rupasinghe, Gloria Hilton, Kidist Yimin and J. Abiodun Elegbede (University of Nevada, Las Vegas, Las Vegas, NV)

Perillyl alcohol (POH), a cyclic monoterpene found in human foods of plant origin, has been shown to have chemopreventive effects in different human cancer models. POH is currently being evaluated in human clinical trials as a chemotherapeutic agent against a number of human cancers not including head and neck. We studied the effects of POH on human head and neck cancer cell (HNCC) lines (Broto, HTB 43, and HTB 54) cultured *in vitro*. Cancer cells were grown on tissue culture plates and exposed to varying concentrations of POH for up to 48 hr and the cell response was measured using biochemical assays. Specifically, we used dye exclusion, mitochondrial dehydrogenase activity and colony formation assays to follow the response of HNCC to POH. Our results show that POH inhibited the proliferation of HNCC. We found that inhibition of proliferation was as a result of cytostatic effects at low concentrations and induction of cell death at higher concentrations. We propose to use flow cytometry and other techniques to elucidate the nature of observed cytostatic and cytotoxic effects.

2:30 - 2:45 EFFECTS OF PRESCRIBED BURNS AND DOMESTIC WOOD SMOKE ON PM-2.5 IN FLAGSTAFF, AZ

Amanda Thompson (Northern Arizona University, Flagstaff, Arizona)

Particulate Matter with a diameter of $\leq 2.5\mu\text{m}$ (PM-2.5) was measured for 24-hour periods from October through November at four locations within Flagstaff. The sampling was performed using four AIRMetrics MiniVol Portable Air Samplers. The purpose of this experiment was to determine if domestic wood burning and local prescribed burns cause any PM-2.5 measurement to exceed the 24-hour EPA standard of $65\mu\text{g}/\text{m}^3$ during the sampled days. The highest level of PM-2.5, $55\mu\text{g}/\text{m}^3$, was measured near a prescribed burn that lasted one hour. The results indicated compliance with the standards during all sampling days. Prescribed burns were infrequent and precipitation was common throughout October and November. The unusual conditions may have resulted in lower PM-2.5 measurements compared to those of a typical burn season.

2:45 - 3:00 ESTIMATION OF AIR QUALITY FROM THE COMPILATION OF EMISSION INVENTORIES FOR THE MESKWAKI NATION

Walter H. Begay Northern Arizona University, Flagstaff AZ

The 1990 Clean Air Act Amendments (CAAA) provided authority for Tribes to implement air management programs and instructed the Environmental Protection Agency (EPA) to adopt regulations so that eligible Tribes may manage their own EPA-approved air pollution

control programs under the Clean Air Act (CAA). These Tribal Implementation Plans (TIPs) include attainment and maintenance strategies for achieving and protecting the National Ambient Air Quality Standards (NAAQS). The nature and extent of known area and point sources for six criteria pollutants and ammonia for central Iowa is assessed for the Sac and Fox Tribe of Mississippi (Meskwaki) in Iowa within EPA Region 7. The EPA established a new more stringent 8-hour ozone standard. The U.S. Congress followed with a federally mandated implementation deadline (September 2000). This Congressional action obligates Tribes to declare all areas, including Tribal lands, to be designated as attainment or nonattainment in meeting the ozone standard. This was the first attempt in EPA Region 7 to assess air quality for Indian Country within the region. An emissions estimate was taken from existing data for 1996-1999 from Aerometric Information Retrieval System (AIRS), National Emissions Trends (NET), and Iowa databases. Based on the state of Iowa's monitoring network, the Meskwaki Tribal lands is in attainment.

3:00 - 3:30 COFFEE BREAK in LOBBY

CONSERVATION SECTION

SESSION 1 8:00

ROOM: C - 216

Chairperson: Vicki Webb

8:00 – 8:15 DNA BASED ANALYSIS OF FECES FOR ESTIMATING SIZE OF A SONORAN DESERT MOUNTAIN LION POPULATION

Ted McKinney (Arizona Game & Fish Department, Phoenix, AZ) and Brad McRae (School of Forestry, Northern Arizona University, Flagstaff, Arizona)

We conducted a preliminary study to genotype mountain lions (*Puma concolor*) using muscle and fecal samples collected in the Upper Sonoran Desert, Arizona, under drought conditions. We successfully genotyped individuals at 14 microsatellite loci using DNA isolated from muscle samples, but we were unable to amplify microsatellites from only 1 of 10 fecal samples, successfully amplifying 2 of 2 trial loci in that sample. A survey of researchers experienced with DNA-based analysis of mountain lion feces to identify individuals revealed that the procedure is problematic and generally yields unreliable results. Our findings suggest that molecular genetic techniques to genotype individual mountain lions using feces presently offer little management level utility for estimating population size in the Upper Sonoran Desert.

8:15 – 8:30 DETECTING THE EFFECTS OF NONNATIVE FISH PREDATION ON A NATIVE FISH POPULATION WITH THE HELP OF ROSA LEE (LEE'S PHENOMENON)

Mark J. Brouder, (Arizona Game & Fish Department, Phoenix, AZ)

I quantified age and growth of a native cyprinid, the roundtail chub, *Gila robusta*, using otoliths extracted from fish collected in the upper Verde River. More specifically, I 1) back-calculated length at age of roundtail chub, 2) observed mean back-calculated length at age for both "young" and "old" fish, and 3) regressed the distance from the nucleus of each otolith to the first annulus against age, to examine for the presence of Lee's Phenomenon. Lee's phenomenon (back-calculated lengths at age of older fish are smaller than those of younger fish) was not present in the upper Verde River roundtail chub population. However, reverse Lee's phenomenon (back-calculated lengths at age of older fish are larger than those of younger fish) was apparent, indicating that year-classes were comprised of faster growing individuals that likely escaped predation sooner than did slower growing individuals of the same brood (i.e., the slower you grow, the longer you are susceptible to predation). Consequently, faster growing individuals frequently tend to mature earlier and therefore die of old age sooner than slower growing fish. In terms of conservation of native fish populations, nonnative fish predation impacts slower growing individuals directly by removing them from the population, leaving behind faster growing individuals, which subsequently die sooner. Continuous removal of slower growing individuals of a population over an extended period of time may prove detrimental to the prolonged existence of a species like roundtail chub, which recruits a strong year-class in response to late-winter/early-spring floods approximately every 5-7 years. If the current

estimated life expectancy of roundtail chub (7-10 years) is reduced by selective predation of slower growing fish, the periodic recruitment of strong year classes that appears to be keeping the population in tact, may cease to continue.

**8:30 – 8:45 DISPERSAL PATTERNS OF FLEDGLING CACTUS FERRUGINOUS
PYGMY-OWLS (*Glaucidium brasilianum cactorum*) IN SOUTHERN
ARIZONA**

Renee L. Wilcox, Michael F. Ingraldi, Dennis J. Abbate, and Sarah Lantz (Arizona Game and Fish Department, Phoenix, AZ)

Known populations of Cactus ferruginous pygmy-owls (CFPO) appear to be patchily distributed. Therefore, documenting dispersal patterns (e.g., potential corridors) of pygmy-owls is an important consideration for future conservation planning. We quantified dispersal movements for first year CFPO in southern Arizona by radio tagging eight fledglings in 1999 and seven in 2000. We were able to track 11 pygmy-owls (n = 5 in 1999 and n = 6 in 2000) for greater than 15 d post-independence and results were compiled for these 11 individuals. For 1999, the mean dispersal period began 54 days (range = 43 to 65 d) after fledging. The maximum amount of days juveniles were followed post-independence was 63 d (mean = 44 d). The maximum mean dispersal distance from natal areas was 18.3 km (range = 3.1 to 39.2 km). In 2000, the mean dispersal period began 57 days (range = 30 to 64 d) after fledging. The maximum amount of days juveniles were followed post-independence was 152 d (mean = 88 d). The maximum mean dispersal distance from natal areas was 9.4 km (range = 2.6 to 18.9 km). All juveniles tracked (for 1999 and 2000 season) remained in the same vegetation type as their natal area throughout tracking period (semi-desert grassland and Sonoran desert scrub). There appears to be some difference in dispersal patterns between male and female pygmy-owls and between pygmy-owls dispersing within Sonoran desert scrub and semi-desert grassland vegetation types. Results will serve as a foundation in describing movement patterns, distinguishing corridors, and identifying other important factors for dispersing pygmy-owls in Arizona.

**8:45 – 9:00 HABITAT CHARACTERISTICS USED BY RAZORBACK SUCKERS
RELEASED INTO THE IMPERIAL DIVISION, LOWER COLORADO
RIVER, CALIFORNIA-ARIZONA; PHASE III SYNOPSIS AND
OVERVIEW OF PHASE IV**

Scott D. Gurtin and Schuyler J. Sampson (Arizona Game & Fish Department, Phoenix, AZ)

Between January 1998 and December 1999, 100 adult razorback suckers (413-553 mm TL) were implanted with ultra-sonic transmitters and released into the lower Imperial Division, and their use of habitat was monitored. Available aquatic habitat within the study area was categorized as main channel, backwater, side channel or impoundment, and was described in terms of surface area and an array of measured habitat characteristics during each survey. We monitored fish distribution among habitat types at 2 to 3 week intervals. The fish used all habitat types, but did not use them in proportion to their availability. Backwaters continued to be selected more frequently than would be expected based on their relative availability. Two separate logistic regression models were developed for predicting use of specific backwaters based on measured habitat characteristics. The models predict use of backwaters poorly, however, non-use of backwaters can be predicted fairly well using select habitat characteristics. The results provide evidence that selection of backwaters by razorback suckers is not dependent

on dynamic habitat characteristics (water quality) that we measured, but rather selection is likely based on backwater physical characteristics. Restoration of isolated backwaters (and associated Phase IV research) began in December 1999 and was completed in autumn 2000. Similar research on flathead catfish began in autumn 2000.

9:00 – 9:15 CACTUS FERRUGINOUS PYGMY-OWL (*Glaucidium brasilianum cactorum*) KNOWN DISTRIBUTION AND DEMOGRAPHICS IN ARIZONA; A REVIEW OF THE MOST RECENT SURVEY AND MONITORING RESULTS

Dennis Abbate (Arizona Game & Fish Department, Phoenix, AZ), W. Scott Richardson (Arizona Game & Fish Department, Tucson, Arizona), Renee L. Wilcox (Arizona Game & Fish Department, Phoenix, AZ) and Michael F. Ingraldi (Arizona Game and Fish Department, Phoenix, AZ)

In response to reported population declines, the Arizona Game & Fish Department (AGFD) initiated formal surveys for Cactus ferruginous pygmy-owls (CFPO) in 1993 to begin documenting numbers and distribution in Arizona. Despite numerous surveys within areas considered CFPO habitat and at specific sites that were historically occupied, these early surveys had limited success. Two individuals were detected during the first year, three in 1994 and six in 1995. For the first time since surveys by AGFD began, one nesting pair of CFPO was located and monitored throughout the breeding season in 1996. Increased survey and monitoring efforts by AGFD, other agencies and contract biologists from 1996 to the present, have resulted in location of up to 11 nest sites during 1999 and identification of five geographic areas currently occupied by CFPO. However, during monitoring visits in year 2000, nesting was detected at only five sites. Intensive nest monitoring, color banding and radio-telemetry have provided the opportunity to monitor this small population. We report on our current understanding of CFPO distribution and demographics based on the most recent surveys and monitoring efforts, which are providing vital information for the recovery of this species in Arizona.

9:15 – 9:30 JUVENILE GROWTH OF NATIVE FISHES IN THE LITTLE COLORADO RIVER AND IN A THERMALLY MODIFIED PORTION OF THE COLORADO RIVER

Anthony T. Robinson and Michael R. Childs (Arizona Game & Fish Department, Phoenix, AZ)

We estimated juvenile growth rates of four native fishes using the von Bertalanffy growth equation and length data from fishes captured during 1991-1994 in the Little Colorado River, a tributary to the Colorado River in the Grand Canyon. We compared growth rates to water temperatures for all four species and modeled the effects of warming the Colorado River (through a retrofit of Glen Canyon Dam) on growth of age-0 emigrants from the tributary. Juvenile growth rates in the Little Colorado River were fastest for flannelmouth sucker *Catostomus latipinnis*, slowest for speckled dace *Rhinichthys osculus*, and intermediate for humpback chub *Gila cypha* and bluehead sucker *Catostomus discobolus*. Growth rates for each species were positively correlated with water temperature; flannelmouth sucker exhibited the strongest relationship followed by speckled dace, humpback chub, and bluehead sucker. Our model indicates that native fish that immigrate into the cold Colorado River (8-12°C) from the relatively warm Little Colorado River within the first three months of life will grow very little by the end of their first year. Based on other studies, it is likely that older, larger fish that disperse into the Colorado

River are more likely to survive than those that migrate as larvae. Growth, and possibly survival, of native fish larvae that drift from tributaries into the Colorado River could be increased if water released from Glen Canyon Dam is warmed during the period of larval drift.

9:30 – 9:45 A.M. DESERT BIGHORN ON PUSCH RIDGE

James C. deVos, Jr. (Arizona Game & Fish Department, Phoenix, AZ)

The desert bighorn sheep (*Ovis canadensis mexicana*) occupied most southwestern mountain ranges prior to European settlement. Due to a variety of factors including introduction of diseases, competition for food resources, excessive harvest for subsistence purposes, and land alterations, many bighorn sheep populations were extirpated or greatly reduced in population size in the early 1900s. The Santa Catalina Mountains, in central Arizona was one of the last mountain ranges in Arizona where commercial harvest occurred. Until the early 1970s, a large population of bighorn sheep persisted in this area. Researchers documented a number of changes that were occurring in the area of the mountain occupied by bighorn sheep including increased vegetative cover due to fire suppression and increased human presence. I wrote a report in 1978 that predicted the extirpation of this bighorn sheep population unless active management, including the reintroduction of fire and limiting habitat encroachment by human was implemented. Few of these recommendations were implemented and bighorn sheep no longer are a viable component of the mountain system where they were once abundant. In the Tucson Basin, there were several groups of bighorn sheep that comprised a metapopulation and, in all likelihood, in a short period of time, all of these groups will be extirpated.

9:45 – 10:00 AFRICANIZED HONEYBEES AT WATER DEVELOPMENTS IN SOUTHWESTERN ARIZONA

Michael J. Rabe, Steven S. Rosenstock (Arizona Game & Fish Department, Phoenix, AZ), and David Nielsen (University of California, Davis, California)

Some researchers have suggested that large numbers of feral honeybees (*Apis mellifera*) may deter wildlife from visiting waters. The recent arrival of Africanized honeybees (*A. m. scutellata*) in Arizona has implications for human as well as wildlife visitors to waters. In June 2000, we collected honeybees at 54 water developments in southwestern Arizona. We hand-collected 10 honeybees from each site on the Yuma Proving Ground (U.S. Army), Kofa Wildlife Refuge (U.S. Fish and Wildlife Service) and adjacent Bureau of Land Management lands. We isolated mitochondrial DNA to identify the genetic origin of each honeybee. The majority (87%) of bees we collected were Africanized, 4% were of Eastern European origin, 6% were Western European, and 3% were Egyptian honeybees. To date, we have observed no antagonistic relations between honeybees and wildlife at waters. The widespread presence of Africanized honeybees suggests that field personnel and others should use caution when working in areas where colonies of feral bees may be encountered.

10:00 - 10:30 COFFEE BREAK in LOBBY

10:30 – 10:45 WHAT ROLE DO EXOTIC CRAYFISH PLAY IN SOUTHWEST AQUATIC SYSTEMS?

James C. deVos, Jr. and Michael R. Childs (Arizona Game & Fish Department, Phoenix, Arizona)

Crayfish are not native to the Colorado River Basin, but have been introduced into most waters on the Colorado Plateau. Two species are present in Arizona, the red swamp crayfish (*Procambarus clarkii*) and the northern crayfish (*Orconectes virilis*), with the later being most widespread. Previous research found that in general, crayfish occupy various trophic levels including being important primary consumers, carnivores, and decomposers, and hence, play a vital role in bioenergetics. In the Southwest, research has shown that crayfish consume a variety of vertebrates including frogs, snakes, and fish. We used 20 commercial crayfish traps (10 points with 2 traps) to sample 11 sites in northern Arizona to determine catch per unit effort (CPUE), length (mean carapace length) and weight of captured crayfish. We also captured northern crayfish and speckled dace (*Rhinichthys osculus*) from the wild and conducted laboratory experiments with these animals to evaluate predation rates and behavioral response when the two species were placed in the same aquarium. Predation on both juvenile and adult speckled dace was observed. When together, crayfish displaced speckled dace from their preferred habitat. Based upon this research, combined with studies of others, we believe that crayfish play a complex role in the aquatic ecosystem including direct predation, nutrient binding, and displacing native fish, thus making them more susceptible to predation by introduced predatory fish species. We believe it is important to focus research on methods to reduce crayfish densities in many southwestern waters to aid in the restoration of native fish populations.

10:45 – 11:00 FINE SEDIMENT RELATIVE TO TWO THREATENED FISH SPECIES: CONSERVATION AND MANAGEMENT IMPLICATIONS

John N. Rinne (Rocky Mountain Research Station, Flagstaff, Arizona)

The spikedace (*Meda fulgida*) and loach minnow (*Rhinichthys cobitis*) are two federally threatened species of native fishes in the Gila River Basin. Research and management continually must determine and address factors that negatively impact these two species. Substrate fine sediment produced by land use activities is frequently suggested as a contributor to the demise of these two species. Data will be presented illustrating: 1) macro- and microhabitats used by these two species in two desert rivers; 2) substrates used by both; 3) fine content of these substrates; 4) other factors that may negatively impact the two species; and 5) the probability of fine sediment being a primary causative factor effecting the demise of these two species. Based on data, implications for conservation, management, and sustainability of these two species will be suggested.

11:30 – 1:40 ANNUAL ACADEMY AWARDS LUNCHEON AND BUSINESS MEETING - Tam Alumni Center, Grand Hall

GEOLOGY SECTION

SESSION I: 9:00

ROOM: C - 230

Chairperson: Richard L. Orndorff

9:00 - 9:15 MICROCLIMATE CONTROLS ON PERENNIAL SNOW IN THE SNAKE RANGE, NEVADA

Richard Orndorff and John Van Hoesen (UNLV, Las Vegas, NV)

The Snake Range is located in east-central Nevada approximately 300 miles north of Las Vegas. Nevada's only modern glacier rests in a deep cirque on the north side of Wheeler Peak, and the landscape is marked by glacial and periglacial landforms. This study is significant because the Snake Range is the closest modern analog to late Quaternary paleoclimatic conditions in the interior Great Basin. The preservation of a modern glacier and the fact that protected snowbanks often last throughout the year make this an ideal place to study topographic controls on perennial snow. We use ArcView GIS to estimate the distribution of perennial snow for modern and late Pleistocene climate based on topography and solar radiation. Slope aspect and shading control the amount of insolation received by a surface; we compute shading effects and seasonal variability based on the sun's position at the summer and winter solstices. We derive slope and curvature from the DEM to estimate the stability and accumulation of snow. In addition, elevation itself is an important control on the quantity of winter precipitation. We combine the above variables to estimate the spatial distribution of snow.

9:15 - 9:30 GIS ANALYSIS OF THE LEHMAN CREEK WATERSHED, GREAT BASIN NATIONAL PARK, NEVADA

Glonek, Lisa and Richard L. Orndorff, University of Nevada, Las Vegas, Las Vegas, NV

Effective discharge is defined as the stream flow that transports the most sediment throughout a long duration of time, hence, it is also the flow that is responsible for controlling channel shape. Effective discharge is calculated from flow and sediment transport data for two sites in Lehman Creek, an alpine stream in Great Basin National Park, NV. A GIS database for the Lehman Creek drainage basin is used to delineate watersheds for the two sites and compare characteristics such as drainage area, slope aspect, and relief.

Four sets of elevation data were downloaded from the USGS to create a DEM for the national park. Hydrological analyses were performed using the Hydrologic Modeling extension to fill sinks in the DEM, determine flow directions, and delineate streams. The DEM with delineated streams was compared to 7.5 minute topographic maps and aerial photographs of the national park to determine if there were any discrepancies with identified stream channels between the paper and digitized maps. A script was applied to the DEM for delineation of the two Lehman Creek watersheds, and then spatial characteristics were compared as possible controls on effective discharge.

9:30 - 9:45 *PALEOECOLOGY OF LOWER CAMBRIAN REEFS IN ESMERALDA COUNTY, NEVADA

Melissa Hicks (University of Nevada, Las Vegas, Nevada)

The Lower Cambrian marks the emergence of metazoan-built reefs. Archaeocyaths (calcareous sponges) and calcimicrobes (e.g., *Renalcis*) constructed these early reefs on shallow carbonate platforms. As part of my thesis, I correlated four localities of upper Lower Cambrian archaeocyathan-calcimicrobe reefs in the upper Harkless Formation in Esmeralda County, Nevada. These reefs are lens-shaped patch reefs ranging in size from 1 m long and 0.5 meters high to 15 meters long and 1 m high. In some reefs, archaeocyaths compose an estimated 50 percent of the reefs, creating an infrastructure conducive for extensive lateral and vertical growth. *Renalcis* is found pervasively within the reefs acting as a binding entity that adds strength and stability to the infrastructure. Reef dwellers such as ostracods, trilobites, echinoderms, and (in one locality) coralomorphs are present.

All reefs formed on a shallow carbonate platform, are surrounded by grainstone, and are capped by siltstone/fine sandstone. It appears that a regional sea level fall might be the culprit that brought about the end of these particular reefs. However, at the end of the Early Cambrian, archaeocyathan-built reefs disappeared globally. Events that led to this global collapse of the archaeocyathan reef ecosystem are poorly understood. The Esmeralda County reefs are some of the youngest archaeocyathan-built reefs in the world, and therefore, could provide clues to the processes that cause reef communities, ancient and recent, to decline.

9:45 - 10:00 GEOMETRY OF MESOZOIC(?) CONTRACTIONAL STRUCTURES: STRUCTURAL CORRELATIONS WITHIN THE CENTRAL NEVADA THRUST BELT: EAST-CENTRAL GREAT BASIN, NEVADA

Gilbert Joseph J., and Taylor, Wanda, J. Geoscience (UNLV, Las Vegas, NV)

The Mesozoic (?) age Central Nevada Thrust belt (CNTB) is a N/S trending fold and thrust belt that represents shortening within the hinterland of the Sevier orogenic belt. Subsequent dissection by Cenozoic normal faults makes delineation of CNTB structures difficult. This study documents contractional structures and Cenozoic normal faults in the central Pancake Range, Nye County, Nevada, and correlates contractional structures to the CNTB.

Field relations document the presence of an E-vergent, N-striking (N23°E/46°W) thrust fault, the Ike Springs thrust. The Ike Springs thrust and related contractional structures are cut by up two three sets of Cenozoic normal faults. The Ike Springs thrust places Devonian strata over Mississippian/Pennsylvanian Antler foredeep strata. These structures may correlate with the Pancake thrust mapped further north, and may lie structurally higher than thrusts mapped to the south and east.

10:00 - 10:30 COFFEE BREAK in LOBBY

11:30 - 1:40 ANNUAL ACADEMY AWARDS LUNCHEON AND BUSINESS MEETING - Tam Alumni Center, Grand Hall

SESSION II 2:00

ROOM: C - 230

Chairperson: Richard L. Orndorff

2:00 - 2:15 A TWO PHASE YOUNGER DRYAS RECORD IN THE AMERICAN SOUTHWEST

Frederick W. Bachhuber (University of Nevada, Las Vegas, Las Vegas, Nevada)

The Estancia Valley, Central New Mexico contains an exquisite sedimentologic and biostratigraphic record of multiple, freshwater, pluvial-lake stands separated by saline lake and dry playa sedimentation. The Late Glacial Maximum (LGM) pluvial lake equivalent, dated at about 19,700 yr B.P. was previously believed to be the deepest lake stand, and the one responsible for the highest elevational strandlines surrounding the valley. The last lake stand, Lake Willard, is believed to be a record of the Younger Dryas, a climatic interval well documented in Europe, and dated at ca. 11,000 to 10,000 yr B.P. Based on various types of evidence, it was inferred that Lake Willard was significantly shallower and of much smaller surface extent than that of the LGM. New evidence, however, suggests that Lake Willard was likely as deep and nearly as large as the deepest Late Pleistocene pluvial lake of the Estancia Valley. Therefore, the magnitude of climate change during the Younger Dryas was likely comparable to that of the LGM. In addition, Lake Willard has a record of two distinct freshwater stands, 13,700 yr B. P. and 12,500 yr B.P., separated by a significant drawdown to a highly saline or even a dry playa episode. The difference in ages between that of Lake Willard and the Younger Dryas in other areas is attributed to the hard-water effect of the pluvial lake. The two-phase Younger Dryas climatic oscillation is now being recognized in the European record, and its occurrence in the American Southwest indicates that this climatic oscillation may be a global phenomenon.

2:15 - 2:30 *MODELING LATEST PLEISTOCENE LAKES IN THE ESTANCIA BASIN, NM

Easte Warnick, Richard Orndorff, and Frederick Bachhuber (UNLV, Las Vegas, NV)

We model Estancia Basin pluvial lakes using computer programs that estimate stable lake extent from climate and terrain boundary conditions. The land surface is represented by a digital elevation model (DEM). We created grids of modern monthly temperature and precipitation from NCDC station data. We used a soil moisture model to estimate annual runoff, which was then provided as a boundary condition to a pluvial lake model that determined modern equilibrium lake extent. We sequentially perturbed modern temperature and precipitation boundary conditions to investigate effects of climate change on lakes. Resulting gridded overlays were analyzed using the Spatial Analyst extension in ArcView GIS. The models predicted no modern lakes in the presently arid Estancia Valley. Altering temperature and precipitation boundary conditions produced pluvial lakes of varying size. Decreasing temperature and increasing precipitation increased lake area and volume, with extreme changes reflecting climatic thresholds. Changing these boundary conditions at the same time amplified effects of individual change. Hysteresis complicated analysis of results, but ArcView proved to be a useful tool in relating field observation of dramatic lake growth and decline to climatic shifts.

**2:30 - 2:45 A NORTHERN HEMISPHERE 1st MILLENNIUM AD EPISODE OF
SUMMER RAINFALL**

Peter E. Wigand (Great Basin and Mojave Paleoenvironmental, Reno, NV)

Paleoclimatic proxy data from the intermountain West reveal an AD 1st millennium episode of high climatic variability characterized by summer-shifted rainfall and warmer temperatures that dramatically impacted surface and groundwater flux, and generated great variability in vegetation cover, and erosional and depositional processes. Shallow lakes replaced marshlands. Near decadal to multi-decadal cycles of increased rainfall in the northern Mojave Desert and southern Great Basin resulted in greater abundance of grasses and eventually in increased piñon pine density in semi-arid woodlands. Further north piñon pine expanded northward at lower elevations into the Lahontan Basin. Bison populations grew and expanded in the wake of increased grass abundance in the sagebrush steppe of the northwestern Great Basin and the eastern Washington Plateau. Native Americans heavily exploited these bison herds. The Washoe and Northern Paiute shifted their economic emphasis to the harvest of piñon nuts as single-needle pine invaded the west-central Great Basin. In the eastern Great Basin Fremont corn horticulturalists followed the corn-favoring summer-shifted rains northward to the shores of the Great Salt Lake, westward into eastern Nevada, and perhaps as far north as the Snake River Plain. They also hunted the bison herds that became common in the Bonneville Basin. Corresponding increased rainfall evidenced in Dead Sea sediments and in the annual flow of the White Nile made the eastern Mediterranean a bread-basket from the late Hellenistic through the early Islamic periods. Eventual dramatic reduction in regional rainfall at the end of the 1st millennium AD resulted in eastern Mediterranean agricultural, economic, and cultural collapse, and forced retrenchment of peoples in the northern Great Basin.

**2:45 - 3:00 TWO POLLEN RECORDS FROM SOUTHERN ARIZONA AND
NORTHERN SONORA**

Owen K. Davis (University of Arizona, Tucson, Arizona)

Sediment cores of two Southwestern cienegas (marshes) have been radiocarbon dated and palynologically analyzed. Both sites have good preservation, high pollen concentrations, and the continued presence of microfossils of aquatic plants indicates that they have never dried. Animas Creek Cienega 31° 31' N, 108° 55' W, 1562 m elev., Hidalgo Co., New Mexico was cored to 465 cm. Its 14C dates are 157 cm, 3030 +/- 80; 265 cm, 4740 +/- 80; 357 cm, 5310 +/- 80; 452 cm, 7030 +/- 80. Its pollen assemblage is dominated by sunflower, grass, and Chenopods; the later predominates during the middle Holocene 6500 - 5500 yr B.P., while percentages of aquatic pollen and algae are low. Los Fresnos Cienega, 31° 18' N, 110° 20' W, 1510 m elev., Sonora, Mexico was cored to 330 cm. Its 14C dates are 85 cm, 1120 +/- 80; 155 cm, 2160 +/- 155; 205 cm, 2867 +/- 130; 275 cm, 6560 +/- 110; 306cm, 8945 +/- 165. Its pollen assemblage is dominated by ragweed, grass, and Chenopods. From 7500 - 5500 yr B.P. percentages of deteriorate pollen are high and aquatic pollen and algae are low.

3:00 - 3:30 COFFEE BREAK in LOBBY

HYDROLOGY SECTION

Session I **8:00**

ROOM: **C - 222**

Chairperson: Zhongbo Yu

8:00 - 8:15 ***AN ANALYSIS OF THE PROPOSED DECOMMISSIONING OF THE FOSSIL CREEK DAM, NEAR STRAWBERRY, AZ**

Charles Jones and Pat Phillips, (Northern Arizona University, Flagstaff, Arizona)

This study evaluates the possible impacts of a planned decommissioning of a dam to restore a damaged stream to its original condition. The dam is Fossil Creek dam, which is located near Strawberry, Arizona. It was built in 1916 to provide power for rural communities throughout the Verde Valley and the City of Phoenix. Before the dam, Fossil Creek was a perennial stream with one of Arizona's most lush and beautiful ecosystems, continually fed by springs at the rate of about 1,000,000 gallons of water/ hour. As such, the stream served as a unique riparian habitat supporting a variety of native fish and a diverse number of native Arizona fauna and flora. However, operating the dam for hydropower generation required diverting 100% of the stream flow in Fossil Creek. That action has left over 14 miles of the original stream and unique riparian area mostly dry, ecologically barren and aesthetically unsightly for the last 80 years. In an effort to restore the Creek, a coalition of special interest groups have recently signed an agreement with Arizona Public Service (APS) to decommission the dam by 2005. The decommissioning will include partial removal of the dam and other related structures that will lead to a complete restoration of the stream by 2009. This study examines the pre-dam and after dam conditions of Fossil Creek, evaluate a set of alternative methods of restoring the stream using the original ecosystem condition as a benchmark.

8:15 - 8:30 **MANAGEMENT OF SEMI-ARID WATERSHEDS: DECISION-MAKING TOOLS AND TECHNOLOGY TRANSFER**

Malchus B. Baker, Jr. (USDA Forest Service, Rocky Mountain Research Station, Flagstaff, Arizona), Barbara Hutchinson, and Eric Pfirman (University of Arizona, Tucson, Arizona)

The Central Arizona Highlands have been the focus of a wide range of research efforts to learn more about the effects of natural and human induced disturbances on the functioning, processes, and components of the ecosystems found in the region. The use of current electronic technologies provides a unique reference and educational tool for disseminating research findings to scientists, educators, and land management professionals as well as the general public. Phase 1 of this project provided a variety of background material about watershed management and specifically the Beaver Creek Experimental Watershed which is accessible through the World Wide Web. This report discusses how 20-years of data collected on the various experimental watersheds are being put into a relational data base and geographic information system (GIS) that will allow the data to be searched and graphed via the Web. The data base incorporates a variety of factors regarding precipitation, stream flow, sediment, water quality, vegetation, and wildlife.

8:30 – 8:45 *THE COST EFFECTIVENESS OF MULTIOBJECTIVE FOREST MANAGEMENT IN AN URBAN WILDLAND INTERFACE

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

Many cities and towns in the upland areas of the Southwest are built in the middle of dense forests and woodlands. These forests are prone to catastrophic fires, which are major threats to the cities and towns as well as the forest ecosystems themselves. One of these cities is Flagstaff, Arizona. The city is located at 7,000 feet above sea level and at the foot of a 12,500 feet mountain surrounded by the largest continuous ponderosa pine forest in the United States. Because of its location, the city enjoys a four-season climate, one of the most beautiful landscapes and serene environments. Yet, it faces major threats from catastrophic wildfire and flash flood hazards. The latter may occur in the form of rapid flows down the side of the mountain following heavy rainfall or fast melting snow events. This paper evaluates the cost effectiveness of minimizing both wildfire and flood hazards while increasing the area's amenity and commodity resources and maintaining its ecosystem integrity in a multiobjective framework. Amenity resources include aesthetics, ecosystem diversity, wilderness, environmental quality and the area's historical and cultural values, while commodity resources are timber, water, forage and other resources that have economic value. These different management objectives and the various groups, which have stakes in the conditions of the wildland-urban interface, are considered in determining the most cost-effective forest resources management scheme.

8:45 - 9:00 UPDATING HYDROLOGIC TIME- TREND RESPONSE FUNCTIONS OF FIRE IMPACTS

Pete Ffolliott, (University of Arizona, Tucson, Arizona)

Recent fire history in the southwestern United States has renewed the need to learn more about the effects of fire on ecosystem resources. Postfire changes in many of ecosystem resources take place at the time of, or shortly after, a fire occurrence. Magnitudes of these changes can be estimated when quantitative data are available. Knowledge necessary to obtain these estimates is seldom available, however, and estimates must be based on data and information that are available or can be made available at reasonable cost. One approach to making these estimates is through the use of time-trend response functions which represent flows of damages or benefits through time since a fire with these functions. These functions are developed to represent postfire changes in a resource in relation to time since a fire of a known severity or a range of fire severities. The status of updating hydrologic time-trend response functions to estimate the magnitudes of postfire changes in streamflow regimes, sedimentation, and water quality is presented in this paper.

9:00 - 9:15 *READJUSTMENT OF UPPER AND LOWER LAKE MARY DAMS TO REHABILITATE WALNUT CREEK

Abigail Roanhorse and Ethan Barnes, (Northern Arizona University, Flagstaff, Arizona)

Upper and Lower Lake Mary were constructed as water supply storages to augment the City of Flagstaff, Arizona's other sources of drinking water supply. The lakes are located in the upper part of the watershed that drains into Walnut Creek, one of the tributaries of the Little

Colorado River. On its way to the river, the creek passes through Walnut Canyon National Monument a short distance downstream from the lakes. Historically, Walnut Creek might have been a perennial stream. However, developments in the upper part of the watershed, have recently converted the Creek into an intermittently stream. Upper Lake Mary is a large reservoir that has been used both as a source of water supply and for fishing and boating types of recreational purposes. Lower Lake Mary often dries, and a well field nearby is a public water supply for Flagstaff. This study examines the arguments for and against restoring the Walnut Creek watershed by lowering the level of the dams on Upper and Lower Lake Mary to allow increased streamflow. Specific topics discussed include historic conditions, current conditions, and possible future impacts on social and ecological factors.

9:15 – 9:30 *ASSESSMENT AND RECOMMENDATIONS FOR STREAM RESTORATION PLANS IN CLOVER SPRINGS VALLEY, ARIZONA

Joyal, Taylor, Ron Griffiths, Colin Ferguson, (Northern Arizona University, Flagstaff, Arizona)

Many stream morphologies exist along the Mogollon Rim of Northern Arizona. Of these, wetland meadows are unique and critical for the health of the stream ecosystems and the ponderosa pine forests along the Rim. Many of these meadow systems have been incised due to recent anthropogenic and natural activities. In some instances the cause of channelization remains unclear. It is possible that regional incision may have occurred primarily in response to climate change and/or extreme runoff events tied to high seasonal precipitation. Channel incision has lowered the local water table, threatening the riparian ecosystem. In addition, increased erosion reduces downstream water quality. One such degraded system in the Clover Spring Valley has already been incised up to three meters. Anthropogenic activities, such as straightening of stream meanders and road construction, have severely impacted the morphology, hydrology and biology of the stream system in this area. In an effort to restore the pre-disturbance morphology of this system, an interdisciplinary group from Northern Arizona University, in conjunction with the Coconino National Forest Service, has developed a demonstrative plan that includes restoration of the streams natural meanders and removal of a Forest Service road. Previous efforts to alleviate channelization in Clover Spring Valley that involved the construction of check dams have failed. The problem of determining the correct pre-disturbance morphology and the extent to which active and passive restoration methods will be employed must be addressed. This review examines the efforts taken to determine the correct pre-disturbance morphology and evaluates the techniques employed in order to create a more naturally functioning stream ecosystem.

9:30 – 9:45 NONNATIVE, PREDATORY FISH REMOVAL AND NATIVE FISH RESPONSE: VERDE RIVER, ARIZONA, 1999-2000

John N. Rinne, (Rocky Mountain Research Station, Flagstaff, Arizona)

Monitoring fish community structure in the upper Verde River, Arizona for the past 7 years indicates 1) a proportional increase in nonnative species, 2) lack of recruitment of several, larger-sized, longer lived species, 3) dramatic reduction in total number of fishes, 4) and loss of smaller, native species from the community. Habitat changes have occurred due to management activities that could be effecting, in part, these observed changes. Alternatively, the increase in nonnative, predatory species may be negatively impacting native species. To commence to determine if predation is a factor in changes in the native component of the fish community,

predator reduction studies were initiated in 1999-2000. Three sites were treated between October 1999 and October 2000. Using change in recruitment of the three large sized species, desert and Sonora sucker and roundtail chub following periodic (once or twice a year), preliminary results suggest that removal of smallmouth bass, green sunfish and yellow bullhead results in a positive response by these three native species. Only successive years treatment will confirm these results.

10:00 - 10:30 COFFEE BREAK in LOBBY

10:30-10:45 *OROGRAPHIC EFFECTS ON PRECIPITATION IN THE BEAVER CREEK WATERSHED, NORTH CENTRAL ARIZONA

Loretta Gale Morgan and Aregai Teclé, (School of Forestry, Northern Arizona University)

It has been observed that precipitation in an area generally increases with elevation. In this paper, the relationship of precipitation with elevation in the Beaver Creek Watershed of Arizona is evaluated. This is done using precipitation data from 54 rain gages spread at different elevations across the watershed. The gages were operated from 1957 to 1982. The data from these gages are analyzed to determine the relationship between depth of precipitation in inches and elevation in feet above sea level for the area. Comparison of the spatial distribution of precipitation between a wet year (1973) and a dry year (1974) shows varying relationships between precipitation depth and elevation. In 1973, the total annual precipitation amount varied from 26 inches at the bottom to 52 inches on the top of the Beaver Creek Watershed. The precipitation amount for the same area during the dry year of 1974 varied from 7 to 22 inches in the gaged portions of the Watershed. In addition to elevation, other factors that contribute to the differences in precipitation amount with space are slope and aspect. The slopes in the part of the Watershed below the Mogollon Rim are steep while those on top fall gradually along the that part of the Watershed. Separate analysis of precipitation versus elevation along the steeper lower part and the more gradual upper portion of the Watershed show differences in correlation. The correlation between precipitation depth and elevation along the steeper slopes is much better compared with that above the Rim which tends to be much lower.

10:50 - 11:05 *ON EVALUATION OF HYDROLOGIC CHANGES IN QAIDAM BASIN

Li Cheng and Zhongbo Yu, (University of Nevada, Las Vegas, Las Vegas, Nevada)

Water resources play an important role in the ecological system and economic development in the continental desert climate Qaidam basin. Owing to the irregular changes of hydrologic process in different years, it would be difficult for the physical models to simulate these hydrologic processes. The objective of the paper is to examine the nature of the temporal variation of precipitation and runoff based on 40 years hydrologic records in the Qaidam Basin (from 1956 to 1995) and to predict the future change in precipitation. The analysis results indicate that the precipitation increases gradually over the last 40 years, which corresponds to the global climate warming over the same period. Naturally, the increase in precipitation results in the increase in runoff production over the period. There are four stages with different increasing rates over the period (1956 - 1995) of steady increase in precipitation. In general, the long-term precipitation correlates well with the runoff. Because the snow and glacier accumulate for a long

period of time during cold season, the runoff in the Basin does not correlate with precipitation events well in the short term (e.g. yearly). The gray system model is constructed for the precipitation simulation. The model predicted annual precipitation (92.7 mm) for the next drought event is much higher than the average value of the historical draught events.

11:10-11:25 BASEFLOW TRENDS IN THE UPPER VERDE RIVER REVISITED

Daniel G. Neary and John N. Rinne (Rocky Mountain Research Station, Flagstaff, Arizona)

Baseflow trends throughout the Southwest in the upper Verde River were previously analyzed to determine potential impacts on the habitat and sustainability of the native fish fauna. Concerns have been raised periodically about the potentially negative effects of drought, consumptive water use, watershed management, and water diversion on threatened and endangered species such as the spinedace (*Meda fulgida*). The annual minimum daily flows for a 30 year prior to 1995 ranged from 0.42 to 0.71 m³/sec (14.8 to 25.1 ft³/sec). The flow records at Paulden and Clarkdale showed a trend of increasing annual minimum daily flows due to a wetter than average rainfall trend over the period of analysis. A recent proposal by the City of Prescott to pump up to 17.0 million m³ (45 billion gallons) of groundwater from the Big Chino Basin could seriously impact minimum daily flows on the Verde. Pumping the full allotment (equivalent to 0.54 m³/sec) would have eliminated baseflow in the upper Verde River in two of the past 38 years. With baseflow cessation, both native and non-native fish populations would be forced into remnant pools, thereby aggravating an already serious predation problem.

11:30 - 1:40 ANNUAL ACADEMY AWARDS LUNCHEON AND BUSINESS MEETING - Tam Alumni Center , Grand Hall

SESSION II 1:40

ROOM: C - 222

Chairperson: Elizabeth (Britt) Jacobson

1:40 - 1:55 *THE COCONINO GROUNDWATER AQUIFER OF NORTHEASTERN ARIZONA

Ron Morgan, (Hydrologist, The Hopi Tribe, Arizona)

The Coconino Aquifer (C-Aquifer) is a regional groundwater reservoir used for drinking water, irrigation, and industrial uses throughout a large portion of northeastern Arizona. Using water well and oil exploration logs, it is possible to construct a surprisingly detailed picture of the aquifer top and aquifer thickness. Geostatistics is used to interpolate between points in the sparse data set. The geological information can be augmented with geophysical data to increase the resolution of the subsurface topographic image. Geographical Information System grids of the aquifer surface and a digital elevation model of the ground surface can be used to estimate the

drilling depth for any location overlying the aquifer. Detailed explanation of the procedure and graphical illustrations of the results are shown in this study.

2:00 - 2:15 *THE RESPONSE OF TAMARISK TO EXPERIMENTAL FLOWS IN GRAND CANYON

Marianne E. Porter and Michael J.C. Kearsley, (Northern Arizona University, Flagstaff, Arizona)

We examined the response of an exotic tree, *Tamarisk chinensis* to an experimental low steady flow and to a four-day spike flow along the Colorado River in Grand Canyon. Plant density data in newly exposed beach area were collected for 52 transect lines throughout the river corridor study site. These data were collected over a three-month period at a time when the river flow remained near 8,000 cfs and once after a spike flow of approximately 33,000 cfs. The latter is the power plant capacity flow. During the experiment, there was a significant establishment of *Tamarisk* seedlings observed in the newly exposed beach areas, but a 31,500 cfs spike flow in the fall resulted in a similarly significant mortality in the seedlings. This low steady experimental flow through Grand Canyon was designed to create habitat and a food base for native endangered fish. It is important to understand the different responses an experimental hydrograph will have on a system when making management decisions. From the results found in this study, it appears that the rapid establishment of exotic plant seedlings needs to be taken into consideration when altering a streamflow regime.

2:20 - 2:35 POTENTIAL INCREASES IN WATER YIELD FROM PONDEROSA PINE AND PINYON JUNIPER FUEL REDUCTION TREATMENTS

Daniel G. Neary, Malchus B. Baker Jr., and Peter F. Ffolliott (Rocky Mountain Research Station, Flagstaff, Arizona, and University of Arizona, Tucson)

Forest restoration thinnings are being planned and implemented around wildland-urban interfaces throughout the Southwest to reduce fuel loads that have contributed to increases in the numbers and size of catastrophic crown fires. Overstocked ponderosa pine stands with 800 to 3,000 trees/ha will be reduced to densities of 90 to 200 trees/ha. On individual, small watersheds, water yield could increase by 25 to 100 mm/year as a result of the thinning. On larger basins (>40,000 ha), water yields might increase by less than 15 mm/yr since about 10 to 20% of the watersheds would be treated in any one year. Flood peak flows could increase depending on climatic events, the degree to which watershed condition is affected by harvesting, and the speed of understory vegetation recovery. The potential for water yield increases on pinyon-juniper sites is poor due to naturally low water yields. Several case studies in the Southwest will be examined.

2:40 - 2:55 PREDICTING THE VOLUMETRIC WATER CONTENT OF ARIZONA SOILS AT DIFFERENT MISTURE TENSIONS

M.H. Bagour and Donald F. Post, (University of Arizona, Tucson, Arizona)

The volumetric water content (θ_v) of soil cores collected from ten irrigated Arizona soils were measured at 1, 10, 33, and 1500 kPa of soil moisture tension. Eight field soil scientists independently determined the % sand, % clay, stickiness and plasticity of each soil, which ranged

from sand to silty clay textures, and a mean was calculated for each soil property. Laboratory measurements included bulk density and sand fractionation to determine the % fine and very fine sand of each soil. Best fit simple regression equations and correlation coefficients were computed to relate θ_v to these soil parameters. Multiple regression models were also evaluated. All six soil characteristics were significantly correlated to θ_v , and these equations can be used in the field to predict θ_v at different soil moisture tensions. It is better to use the multiple regression prediction equation, because multiple factors were better predictors than any single variable.

3:00 - 3:30 COFFEE BREAK in LOBBY

3:30 - 3:45 USING TEMPERATURE SENSORS TO MONITOR THE SPATIAL AND TEMPORAL PATTERN OF STREAMFLOW IN THE SAN PEDRO RIVER, ARIZONA

David Lawler (University of Arizona and U.S. Geological Survey, Tucson, Arizona)

Current streamflow monitoring techniques in ephemeral desert streams include the use of one or more gaging stations. These stations commonly are spaced too far apart to provide detailed information on the spatial and temporal pattern of streamflow. The erosive nature of flash floods common in ephemeral streams makes the installation of a network of stations impractical from an operational standpoint. A new technique, therefore, is needed for monitoring the spatial and temporal pattern of streamflow in ephemeral desert streams. Streambed temperature is an easily measured variable from which patterns of streamflow frequency and duration can be inferred. To determine the effectiveness of this technique, a network of about 40 temperature sensors was installed in the San Pedro River Basin from the headwaters in Sonora, Mexico, to near the confluence with the Gila River in Arizona (approximately 200 kilometers). Streambed temperature was measured every half hour, at a depth of approximately 10 centimeters, by a thermistor encased in waterproof epoxy and tethered to the stream bank. The current period of temperature monitoring began in May 1999. Data were evaluated on the basis of long-term diurnal fluctuations in streambed temperature. In a dry stream channel, the fluctuation can be as much as 20°C. During periods of streamflow, however, the fluctuation is severely damped. Because of the relation between temperature fluctuations and stream condition, it is possible to detect the presence of streamflow by monitoring streambed temperature.

3:50 - 4:05 *ANALYZING THE FEASIBILITY FOR REROUTING THE RIO DE FLAG WASH IN FLAGSTAFF, ARIZONA

Richard Tappan, Boris Poff and Loretta G. Morgan, (Northern Arizona University, Flagstaff, Arizona)

A significant portion of the City of Flagstaff, Arizona, has been built on the Rio de Flag floodplain. A 100-year flood in the Rio de Flag may result in environmental, economic, social, and human damages that can devastate the entire community. Despite over twenty in-depth studies about the potential for flood hazard of flows in the Rio de Flag, the city has taken very little precautions, except those prescribed by the Federal Emergency Management Agency's (FEMA) Flood Insurance policy issued in 1983. Lately, the Rio de Flag wash has been under study by the United States Corp of Engineers. The Agency, in its draft feasibility report and environmental impact statement, recommends the elimination of an existing detention pond and

the construction of both open and closed channels as well as a new larger detention pond. Some of these recommendations appear questionable and this study analyzes the feasibility study with the focus placed on the effects the proposed recommendation will have on the riparian/watershed ecosystem in the historic portion of the City of Flagstaff as well as on its upstream and downstream parts. This study also address impacts not included in the feasibility study.

**4:10 - 4:25 FINE SEDIMENT RELATIVE TO TWO THREATENED FISH SPECIES:
CONSERVATION AND MANAGEMENT IMPLICATIONS**

John N. Rinne (Rocky Mountain Research Station, Flagstaff, Arizona)

The spinedace (*Meda fulgida*) and loach minnow (*Rhinichthys cobitis*) are two federally threatened species of native fishes in the Gila River Basin. Research and management continually must determine and address factors that negatively impact these two species. Substrate fine sediment produced by land use activities is frequently suggested as a contributor to the demise of these two species. Data will be presented illustrating: 1) macro- and microhabitats used by these two species in two desert rivers; 2) substrates used by both; 3) fine content of these substrates; 4) other factors that may negatively impact the two species; and 5) the probability of fine sediment being a primary causative factor effecting the demise of these two species. Based on data, implications for conservation, management, and sustainability of these two species will be suggested.

4:30 - 4:45 LABOR DAY STORM OF 1970 REVISITED 30 YEARS LATER

Pete Ffolliott, (University of Arizona, Tucson, Arizona) and Malchus B. Baker, Jr. (USDA Forest Service, Rocky Mountain Research Station, Flagstaff, Arizona)

The 1970 Labor Day Storm caused more loss of human life than any other storm in Arizona's recent history. Many dwellings, roads, bridges, and other structures were also damaged or destroyed by the record flooding. Widespread and unprecedented losses occurred in central and northeastern Arizona, with other losses reported in southeastern Utah and southwestern Colorado. Flood-damaged areas were declared a major disaster, permitting political jurisdictions and, in a restricted sense, private entities to be reimbursed by the Federal Government for eligible expenditures made as a result of the storm. Initial expenditures to repair storm damages to infrastructures approximated \$25 million in terms of current dollars. Meteorological and hydrologic features of the storm, the resulting upland watershed damages, and relationships to land management practices are reviewed and the degree to which upland watershed damages have been mitigated in the 30 years since the Storm are presented in this paper.

**4:50 - 5:10 SNOWPACK-RUNOFF RELATIONSHIPS FOR THE WORKMAN
CREEK WATERSHEDS IN CENTRAL ARIZONA**

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

The three Workman Creek watersheds in the Sierra Ancha Experimental Forest, north of Globe were instrumented in 1938 to study the hydrology of mixed conifer forests and to determine changes in streamflow and sedimentation resulting from manipulating the forest cover.

Several treatments were applied to the South Fork and North Fork watersheds while the Middle Fork watershed was retained as a hydrological control. Runoff increases resulting from the 1967 treatments remained constant and the watersheds were deactivated in 1983. In April 2000, the Coon Creek wildfire burned across the watersheds; Middle Fork was severely burned. The watersheds were re-instrumented in June 2000 to measure the effects of the wildfire on forest hydrology and sediment dynamics. The USDA Soil Conservation Service (now the Natural Resources Conservation Service (NRCS)) established a snow course within Middle Fork in 1951, which was later replaced by a SNOTEL station, to index snowpack conditions within the Sierra Ancha Mountains, immediately east of Roosevelt Reservoir. The Rocky Mountain Research Station would like to reinforce its current data acquisition and interpretation efforts by using NRCS data. Snow water equivalent data from the NRCS site are evaluated to determine if they can be used to characterize past winter runoff volumes from Middle Fork since 1951 and from the other two watersheds since the last treatments. Significant relationships between these data sets could provide another basis for evaluating pre- and post-fire winter runoff.

POSTER SESSION

SESSION I 10:00

ROOM: Classroom Building Complex – Lobby

Chairperson: Robert Reavis

10: 00 - 10:30 NONDIPOLE ANGULAR DISTRIBUTION EFFECTS IN CO BY TIME-OF-FLIGHT PHOTOELECTRON SPECTROSCOPY

Maraya Lotrakul, Dr. Oliver Hemmers and Dr. Dennis Lindle (University of Nevada, Las Vegas Las Vegas NV)

Both dipole and nondipole parameters β and β' were measured simultaneously for carbon monoxide at energies near the C1s and O1s ionization thresholds. Angular distribution patterns of high accuracy were obtained by using nearly 100% polarized X-ray photon pulses at 328ns intervals and a time-of-flight electron detection chamber designed specifically to measure higher order corrections to the dipole approximation (DA). These first ever measurements of nondipole effects in CO are made possible by two of the four analyzers positioned at the magic angle ($\theta = 54.7^\circ$), where the dipole parameter $\beta = 0$. The angular distribution results for the CO 1s shells indicate strong nondipole effects that are significant and measurable at energies close to the core ionization threshold. These unexpected effects are of particular consequence for the dipole approximation (DA), which is used to interpret angular resolved photoionization data. Our analysis of CO and other small molecules indicate that the DA may not be valid at lower photon energies, where it has been assumed that nondipole effects are negligible.

10:00 - 10:30 THERMOTROPIC LIQUID CRYSTALLINE PROPERTIES OF VIOLOGEN COMPOUNDS

James J. Cebe, Haesook Han, and Pradip K. Bhowmik (University of Nevada Las Vegas, Las Vegas, Nevada)

The 1,1'-dialkyl-4,4'-bipyridinium ions are usually called viologens. They are interesting class of organic compounds, which exhibit a wide number of properties including electrical conductivity, photochromism, electrochromism, and photomechanical behavior. Several series of new viologen compounds were synthesized by the metathesis reaction of various salts both inorganic and organic with the corresponding 1,1'-dialkyl-4,4'-bipyridinium dihalides in appropriate solvents and characterized for their high purity by elemental analysis, ¹H and ¹³C NMR spectroscopy. Their thermotropic liquid crystalline properties were determined by various experimental techniques including differential scanning calorimetry, thermogravimetric analysis, and polarizing light microscopy. The principal purpose of this study was to design and develop both room temperature ionic liquids and room temperature liquid crystalline ionic liquids, which are considered as green solvents in organic and polymer synthesis.

10:00 - 10:30 SYNTHESIS AND CHARACTERIZATION OF IONIC THERMOTROPIC LIQUID CRYSTALLINE POLYESTERS

Joshua J. Nordick, Haesook Han, and Pradip K. Bhowmik (University of Nevada Las Vegas, Las Vegas, Nevada)

A series of ionic wholly aromatic thermotropic polyesters were prepared by the high-temperature solution polycondensation reaction of various quaternary ammonium salts of hydroquinonesulfonic acid and terephthaloyl chloride in 1,1,2,2-tetrachloroethane. They were characterized for their polyelectrolyte behavior in organic solvents by viscosity measurements, and for their thermotropic liquid crystalline properties by various experimental techniques including, differential scanning calorimetry, thermogravimetric analysis and polarizing light microscopy. The purity of both monomers and polymers was determined by elemental analysis, ^1H and ^{13}C NMR spectroscopy. These polyesters were designed to combine ionic and thermotropic liquid crystalline properties into a single polymer chain. They have a great potential for the creation of new generation of polymer blends by significantly improving the compatibility between various thermoplastic polymers through the strong ionic interactions.

10:00 - 10:30 *VERTICAL DISTRIBUTION OF ARBUSCULAR MYCORRHIZAE ASSOCIATED WITH MESQUITE

Lara Aniskoff, Rachel Ganiere, Caroline Ortmann, Daniel Chern, Jennifer Griffith, Marnie Layton and Jonathan Titus (Columbia University's Biosphere 2 Center, Oracle, Arizona)

Mesquite (*Prosopis glandulosa*) develops a mutualistic relationship with arbuscular mycorrhizal (AM) fungi. The depth distribution of mycorrhizal propagules, AM colonization of mesquite roots, and spore counts were determined at each 10 cm depth interval in three 1 m deep pits. The density of mycorrhizal propagules or mycorrhizal inoculum potential (MIP) was determined by glasshouse corn bioassays where corn was planted in soil and the corn roots examined for mycorrhizal colonization to yield MIP. Fine mesquite roots were collected wherever they occurred across the depth gradient, stained and assessed for AM colonization. Spore densities were determined by wet sieving 10 ml soil samples. Preliminary data shows MIP to be highest in the top 20 cm of soil at $38 \pm 14\%$ AM root colonization, to decrease dramatically in the caliche layer to $9 \pm 6\%$ and then to increase again below the caliche layer to $29 \pm 11\%$. Spore densities showed a decrease with increasing depth from a high of 0.6 ± 0.4 spores/ml soil to a low of 0.1 ± 0.2 spores/ml soil. The high variability exemplifies the heterogeneity of spore distribution. A decline with depth was also observed in AM colonization of mesquite roots. The vertical gradients in AM showed similar patterns in each of the three pits. Thus, AM propagule density, colonization and spore abundance change with depth in arid systems with a decrease from the surface to the caliche layer and an increase in the soil below the caliche layer.

10:00 - 10:30 ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN CALCAREOUS DESERT SOIL USING ION TRAP GC/MS AND SOLID-PHASE MICROEXTRACTION

Mary F. Turner, Spencer M. Steinberg (University of Nevada, Las Vegas, Nevada)

Volatile organic compounds (VOCs) can be released into the environment as a result of fuel spills, leaking underground storage tanks, and soil fumigation. Many VOCs are highly toxic

and highly mobile and may easily migrate to groundwater. Conventional analysis of VOCs in soil uses dynamic headspace concentration of VOCs in soil samples that have been preserved by addition of NaHSO₄ and water. This technique is difficult to apply to calcareous desert soil because the addition of acid and moisture promotes the loss of VOCs due to effervescence. Solid-phase microextraction with ion trap GC/MS for detection has been implemented as an alternative to dynamic headspace concentration to selectively extract and measure volatile organic compounds in calcareous desert soil. We have also explored the use of soil desiccation (molecular sieves or drying agent), methanol, and solid-phase adsorbents for preservation of soil samples. This analytical technique and preservation method provides high recoveries of VOCs from soil samples, and should be a viable alternative to the conventional procedure.

10:00 - 10:30 INFLUENCE OF DEVELOPMENTAL ENVIRONMENT ON TADPOLE SHRIMP PHYSIOLOGY

Stacey L. Harper and Carl L. Reiber (University of Nevada Las Vegas, 4505 Maryland Parkway, Las Vegas, NV)

Tadpole shrimp *Triops longicaudatus* inhabiting a rock pool in southern Nevada experience prolonged hypoxia. Diel oxygen concentrations (P_{O₂}) in the pool range from 0-20 kPa O₂. Tadpole shrimp were reared under low (1-3 kPa O₂) and high (10-13 kPa O₂) P_{O₂}'s to determine the influence of rearing P_{O₂} on adult responses to hypoxic stress and to determine the regulatory mechanisms employed by tadpole shrimp to deal with both chronic and acute hypoxia. Respiratory surface area is significantly decreased in animals reared under chronic hypoxia. This decrease is presumably due to limited oxygen available to fuel metabolic anabolism and formation of larger respiratory appendages. Accessory respiratory surfaces, such as the hindgut, aid in the diffusion of oxygen into the animal regardless of their rearing environment but appear to primarily assist smaller animals in extracting supplemental oxygen. This is ecologically important because smaller tadpole shrimp cannot regulate oxygen uptake as readily as larger, more mature animals. Ventilatory rates and volume do not change with varying oxygen tensions, however, oxygen extraction increases significantly under low oxygen concentrations in both field and experimental animals. Tadpole shrimp from the rock pool in Brownstone Canyon appear to be highly adapted to the low oxygen concentrations prevalent in the pool.

10:00 - 10:30 THE ONTOGENY OF 5HT IN THE PERICARDIAL ORGANS OF THE FRESH-WATER CRAYFISH, *PROCAMBARUS CLARKII*

Jutta A. Guadagnoli and Carl L. Reiber (University of Nevada, Las Vegas, Las Vegas, NV)

Adult crayfish pericardial organs, as in lobsters are described as emerging from the thoracic nerves and running toward the dorsal surface of the heart, becoming fine fibers that eventually take on a beaded form. Trunks emerge between the epimeral plate and spread over a large area of the membranous tissue lining the lateral pericardial wall and the tissue surrounding the heart ligaments. The PO are release sites for several neurohormones. The adult decapod heart is neurogenic, however it has been hypothesized that a developing embryo's heartbeat is myogenic in origin only later becoming neurogenic. While neurogenic drive arises from the cardiac ganglion, the release of neurohormones from the PO provides additional regulation of heart function. The current study employed methylene blue staining techniques to determine the development of the PO in embryonic crayfish. The heart starts beating in the Nauplius 4 stage and is protruding posteriorly from its future location in the pericardial cavity. In juveniles the PO

appear to be even more extensive than those found in adult crayfish. The PO is present during all three larval instars. At Nauplius 6 and 7, the PO appears to be extensive in the center and anterior portion of the dorsal carapace even though the heart at these stages is still protruding from the posterior end of the carapace. The PO is a site for release of serotonin. In the lobster, serotonin appears as early as 10% development, and has nearly its full complement of serotonergic fibers by 40-50% development. In other vertebrate systems, serotonin appears to play a role in regulating the pattern of development of neurons and their connections. The appearance of extensive PO during embryonic stages when the heart is still myogenic may imply an additional role for the PO during development. (funded by the Graduate Student Association, UNLV and NSF Grant to Dr. Carl Reiber.)

10:00 - 10:30 *INCONSISTENCIES IN ENVIRONMENTAL STANDARDS APPLIED TO TRANSURANIC WASTE DISPOSAL AT THE NEVADA TEST SITE

Demian Gitnacht, (Harry Reid Center for Environmental Studies, Las Vegas, Nevada)

The Nevada Test Site (NTS) is one of the major radioactive waste disposal areas for the U.S. Department of Energy (DOE), containing two major disposal sites. The focus of this presentation will be on the transuranic (TRU) waste disposed in the Area 5 Radioactive Waste Management Site. TRU waste is typically disposed in the Waste Isolation Pilot Plant (WIPP). However, the waste disposed at the NTS is orphan TRU that does not meet the waste acceptance disposal criteria for the WIPP facility, as it contains classified TRU waste. The orphan TRU waste was emplaced in four Greater Confinement Disposal (GCD) boreholes. GCD boreholes are approximately 3 meters in diameter and 40 meters deep. The bottoms of the boreholes are about 220 meters above the groundwater table.

The presentation focuses on the inconsistencies between the GCD disposal system and the regulations chosen by the DOE for compliance. Studies performed by the Harry Reid Center for Environmental Studies show that the standards determined by the U.S. Environmental Protection Agency (EPA) in Title 40 Part 191 of the Code of Federal Regulations (40 CFR Part 191), are inconsistent with the nature of the waste and the characteristics of the boreholes. Alternatives to these regulations are examined. This work was supervised by UNLV research scientists Dr. Anthony E. Hechanova and Dr. Brett T. Mattingly and funded by a DOE grant # DE FC08 00NV13813.

10:00 - 10:30 *IN SITU* TRITIUM PROBE FOR GROUNDWATER MONITORING

Carter Hull and Anthony Hechanova (University of Nevada Las Vegas, Las Vegas, Nevada)

Tritium (radioactive Hydrogen - ^3H) in groundwaters is an issue at many DOE facilities. The Harry Reid Center for Environmental Studies, UNLV, has teamed with Technical Associates, Canoga Park, California to produce an *In situ* Tritium Probe (ITP) for measuring dissolved tritium in groundwaters. A prototype ITP has been designed and tested under laboratory conditions and in shallow monitor wells. This "Phase I" prototype ITP is capable of being deployed in 2-inch diameter monitor wells and incorporates innovative designs for collecting groundwater samples and performing tritium analyses while in the well. Analytical data are electronically transmitted to the surface, not a water sample. The ITP may be used as either a monitoring tool or a dedicated, *in situ* system for automatically performing tritium analyses and reporting results. A "Phase II" ITP is now being fabricated and will be field-tested in deep monitoring wells at Nevada Test Site. The ultimate goals of this project are to produce survivable tritium detectors with low detection limits that can operate unattended for extended

periods in wells at remote sites. Hydrological applications for the ITP include aquifer remediation verification, reservoir characterization, validation of computational models of contaminant transport, *etc.* Other *in situ* nuclear and chemical measurements such as gamma flux, pH, *etc.* are planned for this downhole probe platform.

10:00 - 10:30 *A CASE STUDY IN RADIATION RISK COMMUNICATION

Christina Crossan, Demian Gitnacht, Cheryl Gustafson, Ingrid James, and John Knoten
(University of Nevada, Las Vegas)

Students and faculty of the University of Nevada, Las Vegas designed and staffed an exhibit at the Town of Pahrump's Harvest Festival, September 15-17, 2000. The purpose of this outreach effort was to communicate radiation science and risk issues that are important to the local community of Pahrump, which is approximately 25 miles from the Nevada Test Site where over 900 nuclear weapons tests were conducted since 1951 and radioactive waste management is an ongoing mission.

This poster describes the innovative techniques used by the students and staff to convey the risks of radiation and the basics of radiation science. Under the guidance of the Town of Pahrump's Nuclear Waste Advisory Board, a number of demonstrations, educational props, and informational handouts were provided. Three props were constructed for the booth: a giant Geiger Counter, a three-dimensional periodic table, and dose flags and radioactive waste containers. Interactive demonstrations of radiation detection were given to over 100 visitors to the booth. Specially developed handouts providing relative risk information as well as introductory material were also distributed at the booth. The effectiveness and impacts of these communication techniques is highlighted. Major conclusions: (1) education of our populace is an important responsibility for trained students and scientists, and a collaboration welcomed by the public; (2) effective communications offered by the students is a welcomed and comforting communications technique; and (3) hands-on materials and show and tell props served this forum well. This work was supervised by UNLV researchers Gary S. Cerefice, Anthony E. Hechanova, and Kathy Lauckner, and funded by a DOE grant # DE FC08 00NV13813.

10:00 - 10:30 *PRELIMINARY ASSESSMENT OF QUATERNARY GEOMORPHIC LANDFORMS IN THE NORTHERN SECTION OF THE PAHRANAGAT VALLEY, LINCOLN COUNTY, NEVADA

Brock, A.L., Buck, B.J, and Orndorff, R.L. (UNLV, Las Vegas, NV)

The Pahrnagat Valley is an externally drained, tectonically active valley approximately 30 miles in length that stretches north-south in the Basin and Range Province. Several strike-slip faults occur in the southern portion of the valley near the Upper and Lower Pahrnagat Lakes and Maynard Lake. The Hiko normal fault runs parallel to the White River wash in the northern section of the valley. The goals of this study are to determine the age and distribution of geomorphic landforms within the Pahrnagat Valley and their relationship to tectonics. Six Quaternary landforms have been tentatively identified in the northern Pahrnagat Valley ranging in age from early Pleistocene to Holocene. Preliminary age relationships are based on geomorphic position, carbonate morphology and other soil development indices. Additional

research will be undertaken in hopes of better understanding the geomorphic evolution and neotectonics of this basin.

10:00 - 10:30 *A SYSTEM DYNAMICS MODEL FOR EXAMINING WATER MANAGEMENT POLICY OPTIONS IN LAS VEGAS, NV

Sarah Williams Cloud and Krystyna A. Stave (University of Nevada, Las Vegas, Nevada)

This poster describes the structure and use of a system dynamics model for evaluating water quantity management options for the Las Vegas, NV water system. The model addresses the local water authority projection that water demand is likely to exceed water supply for the rapidly growing metropolitan area in approximately 2025. The model was developed to evaluate options for extending the point at which demand is expected to exceed supply. It represents key features of the Las Vegas water system structure, including the physical loop created by the withdrawal of water from Lake Mead for the city's water supply, then the discharge of wastewater effluent from the city into Lake Mead at a point six miles upstream from the city's drinking water intake. Six potential management strategies are discussed and analyzed using the model, including residential and commercial conservation, as well as increasing supply. The analysis shows potential benefits and tradeoffs of these policy options.

10:00 -10:30 *RANDOM WALK APPROACH FOR MODELING MATRIX DIFFUSION AND SOLUTE TRANSPORT IN DUAL-POROSITY MEDIA

Hai Huang, Ahmed. E. Hassan and Bill. X. Hu (Desert Research Institute University and Community College System of Nevada, Las Vegas, NV)

A random walk approach is developed to simulate the transport of conservative tracers in heterogeneous flow field coupled with a heterogeneous solute transfer process between the mobile and immobile water. Both the hydraulic conductivity and the mass transfer rate coefficient are assumed to be spatial random variables in this study. A Fast Fourier Transform technique is adopted to generate the random conductivity fields and the mass transfer rate coefficient fields. A block-centered finite difference method is employed to solve the flow equation and a random walk particle-tracking algorithm is adopted to solve the transport equation. The diffusive mass transfer process between the mobile and immobile water is simulated by a 2-state, homogeneous, continuous-time Markov chain. The Markov chain is completely governed by its transitional probability matrix related to the heterogeneous mass transfer rate coefficient. The simulated results, including the spatial moments of the mean plume and the mean solute flux, are compared with the analytical stochastic solution developed by *Huang and Hu* [2000] for conservative transport in dual-porosity media. The comparison demonstrates the validity of the random walk approach developed in this study. Unlike the analytical stochastic approach, the random walk particle-tracking approach relaxes various assumptions required by the analytical approach, such as small log conductivity variance, weakly stationary velocity field, infinite domain size and mean uniform flow field. In addition, the random walk approach also provides uncertainty measures associated with the predicted mean concentration and flux.

**10:00 - 10:30 A NEW APPROACH TO SEA TURTLE CONSERVATION IN
MAGDALENA BAY**

Sandra Embry (Northern Arizona University, Flagstaff, AZ)

Sixteen students participated in continuing research for the draft recovery plan of green sea turtles in Magdalena Bay. The research was coordinated by the Center for Coastal Studies, School for Field Studies (SFS), Boston University. The information gathered will be incorporated into the first recovery plan that includes the feeding grounds of *Chelonia mydas* and *C. agassizzi* in Magdalena Bay, located in Baja, Mexico. Turtle capture, whether intentional or accidental, is measured by counting the numbers of turtle carapaces found in landfills and offshore. Tag-recovery data is another method of counting turtles encountered. Although turtle poaching was banned ten years ago, the mortality rates are still high. The residents of a nearby village have cultural ties to the sea turtle. They use its meat and eggs for ceremonial activities. The goal of this research is to protect sea turtles in Magdalena Bay. A recently established committee is the first step toward reaching this goal. Future plans include establishing a sea turtle haven to promote ecotourism. The local people could then view the conservation of marine turtles as a cultural and economic incentive to prevent their extinction.

**10:00 - 10:30 CHARACTERIZATION OF A DROSOPHILA TUMOR-CAUSING MUTATION,
TU-65**

Placida Martinez*, Elisabeth Kang*, Jennell M. Miller, and Deborah K. Hoshizaki*
*University of Nevada at Las Vegas, Las Vegas, NV

Drosophila melanogaster (fruit fly) has served as a model system for many biological processes, including the immune system. Immune malfunctions render *Drosophila* capable of developing two types of tumors: neoplasms and melanotic pseudo-tumors. We have recently identified a mutation, *tu-65*, that causes melanotic pseudo-tumors. These pseudo-tumors are characterized as black dense masses found in the 3rd instar larvae. Although melanotic pseudo-tumors have been previously described, most melanotic pseudo-tumors are benign and/or have incomplete penetrance. *tu-65* is unusual in that it is a lethal mutation and the penetrance of the melanotic pseudo-tumor phenotype is nearly 100%. We genetically mapped this mutation to the *rough* (3-0.0) *hairy* (3-26.5) interval at position 3-15.4. By cytogenetic mapping, using deficiency mutations, we further located *tu-65* to the cytological interval 64E-65A. To clone the *tu-65* gene, we are carrying out left-right mapping experiments using P-element insertions that are sequence tagged in the Berkeley *Drosophila* Genome Project. The results of these experiments will map the *tu-65* gene to DNA sequences and transcription units of the genome project, and thus facilitate the cloning of this gene.

**11:30 – 1:40 ANNUAL ACADEMY AWARDS LUNCHEON AND BUSINESS
MEETING - Tam Alumni Center, Grand Hall**

SCIENCE EDUCATION SECTION

SESSION I 8:00

ROOM: C - 224

Chairperson: Satish C. Bhatnagar

8:00 - 8:15 BRINGING A LARGE GENERAL CHEMISTRY COURSE INTO THE ELECTRONIC AGE - A CAUTIONARY TALE

Boyd Earl (University of Nevada, Las Vegas, Las Vegas, NV)

In the fall of 1999, I began a rotation in CHE 115, General Chemistry I, at UNLV. Based on several factors, I decided to convert from sketchy, scribbled notes and blackboard presentation, to a "fully electronic" course, with lecture outlines in PowerPoint, and a course web page constructed using WebCT. Now, in the fourth semester of this effort, the electronic structure of the course is well-established, and I have learned some lessons along the way. This presentation will look at the pro's and con's of such a structure from both the students' and teacher's viewpoints. Several related topics will be presented for discussion: types of electronic resources; how we can decide what to incorporate and how to make effective use of what we choose; how we can attempt to mitigate the negative aspects of technology; and whether there is an overall benefit to the students from this type of course design.

8:15 - 8:30 INTER-STATE COLLABORATION AT DOCTORATE LEVEL

Satish C. Bhatnagar (University of Nevada Las Vegas)

Arizona-Nevada Academy of Science is a fine example of collaboration between two neighboring states. Through its periodic meetings over the last forty-five years, it has encouraged faculty and students of two states to come together for sharing ideas on basic research and projects. However, the time has come to take this collaboration at a new and significant level by starting joint doctorate programs in areas of science and mathematics where there is a common pool of faculty expertise. The distance education technology is now ready and cost effective. It will allow students, say at UNLV to take graduate courses, do individual research consultation and participate in a seminar at a site in ASU.

The two states have economically flourished with the availability of water and power since 1940's. State budgets and consequently external research grants are going to be affected by their shortages. Economies move in cycles of surpluses and shortages. Despite increasing private funds, state universities in near future shall find it difficult to support doctorate programs effectively. The paper presents compelling data to justify the feasibility of innovative doctorate programs. A byproduct of such a collaboration will be the enhancement of quality in undergraduate education. It will save huge money by avoiding duplication of shrinking resources. The idea is not to eliminate existing modes of doctorate programs, but to strengthen them while creating new ones.

8:30 - 8:45 MASTER OF ARTS IN SCIENCE, AN ALTERNATIVE DEGREE PROGRAM

Roberta Williams (University of Nevada, Las Vegas, NV)

Eight years ago, the College of Science at UNLV initiated a masters degree program primarily designed for secondary science teachers. This non-thesis degree emphasizes two different fields of science. Each candidate takes 21 graduate credits in one field of science (i.e. Biology) and 12 graduate credits in a different science field (i.e. Geoscience) or statistics. Six of the credits in either field are used to do a project. Twenty-four students have obtained this degree to date, but only half of them have been secondary science teachers. The program became attractive to those who work for government agencies where knowledge in two science fields is critical and a stepping stone for those desiring to pursue careers in medical fields. As a consequence, the projects have been very diverse. Teachers tend to do something that they can use in their classrooms, field scientist do ecology/geology based projects and the others do research projects. Most of the students enrolled in the program work full-time so it takes them about four years to complete the program.

8:45 - 9:00 CLASSES WHOSE MEMBERS HAVE WIDELY DIFFERENT LEVELS OF PREPARATION CAN BE TAUGHT EFFECTIVELY

David W. Emerson (The University of Nevada, Las Vegas, Las Vegas, Nevada)

Instructors teaching lower division courses in public institutions often have classes whose members have widely disparate levels of preparation. There is no "correct" level for teaching these courses. Pacing of courses at the middle ground, if there is such a thing, will be too slow and boring for the better prepared students and too fast for the ill prepared.

Using general chemistry as an example it will be shown that a support system can be devised that will help students and allow the level of discourse in the class and laboratory periods to be raised. Such a support system requires careful thought about what basic skills are required by students in order to succeed and how these basic skills can be learned outside of class. This requires an effective means of teaching each skill before the time it is needed and requires a means of verifying that the skill has been learned. Consistent application of these methods can allow instructors and classes to make efficient and effective use of class and laboratory time.

9:00 - 9:15 ENVIRONMENTAL EDUCATION THROUGH ENSCIDACA 2000

Amy Mracna (Northern Arizona University, Center for Environmental Science and Education, Flagstaff, AZ)

Northern Arizona University offers an Environmental Science Day Camp (Enscidaca) every summer for interested middle school aged children. The purpose of Enscidaca is to offer children the opportunity to conduct hands-on environmental research. Children are also given the opportunity to participate in discussions and give formal presentations about their data. Topics addressed throughout the summer of 2000 included: forest restoration, wildlife, vegetation, arthropods, pond ecology, fire ecology, soils and orienteering. Surveys conducted at the conclusion of camp indicated that participants learned many things and gained a new interest and passion for science and the environment. Children developed a strong stewardship in their

attitudes and actions toward the environment with this gained respect and understanding of how the environment works.

**9:15 - 9:30 DISTINGUISHING BETWEEN SKILL AND PERFORMANCE IN
MATHEMATICS EDUCATION**

K. J. Mourad (University of Nevada, Las Vegas, Las Vegas, Nevada)

The teaching of lower division courses for non-majors, particularly for students who would not otherwise take mathematics courses at the college level, is often characterized as a “skills building” approach as opposed to a conceptual one. The success of this enterprise is then measured by timed performance on algorithmic tasks. It is assumed that there is a requisite correspondence between the way students are evaluated and the inculcating of the desired pedagogic skill. This issue will be explored in the context of the nature of mathematics, a developmental model of learning, and the realities of modern public liberal arts institutions. I claim that we are still implicitly caught in the throes of a behaviorist model, despite the fact that most educators have long ago abandoned that paradigm. Consequently, focus on student performance yields superficial and short-lived results. What often results is a far cry from the lofty image we have of scholar-teachers guiding scholar-students to ever deepening intellectual growth. Rather what develops is a shallow co-dependency in the service of expediency. I will illustrate with examples and put the matter in the context of instructional psychology and instructional design, using a historical model developed by Wilson and Cole (1993). Lastly, I will give some suggestions as to how instructional technology can be used to address the above concerns.

**9:30 - 9:45 GEOLOGIC GUIDE TO RED ROCK CANYON: INTEGRATING
RESEARCH AND EDUCATION**

Bailley, T.L.; Gilbert, J.J; Howley, R.A.; Rees, M.N.; Schiefelbein, I.M.; Taylor, W.J.; and Van Hoesen, J.G., University of Nevada, Las Vegas Las Vegas, NV 89154-4010

This service-based learning project blends research and education for 13 students and two faculty members. This integrated investigation provides geological educational materials to the community. The spectacular scenery of Red Rock Canyon National Conservation Area (RRCNCA), just west of Las Vegas, draws millions of visitors each year, yet no site-specific geology guide is available. This project is creating a geologic guidebook for roads and trails and a new geological map of RRCNCA that will be readily accessible to the public and an essential tool for naturalist guides and other educators. These materials will allow users to better understand the geologic history of RRCNCA, the geological processes that formed the scenery, and the interrelationship of humans and their environment.

Research involved compiling data from scholarly literature and geologic maps as well as collecting and analyzing new data. Global Positioning System (GPS) locations of notable geologic sites along roads and trails were integrated with new digital geological maps, rock descriptions and geologic inter-pretations. Students learned the local geology, data collection and interpretation techniques, literature critiquing, as well as effective writing, editing and communication. They also gained new skills in use of GPS, Geographic Information Systems (GIS) software, GIS to perform analyses, and graphics software. Students' interest and enthusiasm for service-based learning made this project a success.

10:00 - 10:30 COFFEE BREAK in LOBBY

11:30 - 1:40 ANNUAL ACADEMY AWARDS LUNCHEON AND BUSINESS MEETING - Tam Alumni Center, Grand Hall

**ACADEMY BUSINESS
AND
ANNUAL REPORTS**

OFFICERS 2000 - 2001

ELECTED

Owen DavisPresident
Don Young. Past President
Jim deVos President Elect
Betsy CooperRecording Secretary
Ingrid NovodvorskyMembership Secretary
Karen ConzelmanTreasurer
R. Roy Johnson.....Director, Southern Arizona
Robert ScarboroughDirector, Southern Arizona
Robert ReavisDirector, Central Arizona
William Perry BakerDirector, Central Arizona
Jim deVosDirector, Central Arizona
Norm ThomasDirector, Northern Arizona
Aregai TecléDirector, Northern Arizona
Kathy Lauckner.....Director, Nevada
Carl L. ReiberDirector, Nevada

APPOINTED

Owen DavisPermanent Secretary
Tony BrazelEditor, Journal
Stephen WilliamsEditor, Newsletter
Betsy CooperEditor, Proceedings
Lynnette HoffDirector of the Junior Academy

SECTION CHAIRS

William WhiteAnthropology
Robert BowkerBiology
Kathleen RobinsChemistry
Vicki WebbConservation
Richard Orndorff Geology
Elizabeth Jacobson and Zhongbo YuHydrology
Robert ReavisPoster Session
Satish BhatnagarScience Education

COMMITTEE ROSTER

BUD ELLIS SCHOLARSHIP

Stephen M. Shuster

NOMINATING

Owen Davis
Don Young
Jim deVos

MEMBERSHIP

Ingrid Novodvorsky

NECROLOGY

Ingrid Novodvorsky

R. M. HARRIS AWARD

Tony Brazel

PUBLICITY

Robert Reavis

OUTSTANDING SCIENCE TEACHER

William Perry Baker

PROGRAM

Kathy Lauckner
Carl L. Reiber

GRANTS-IN-AID

GRADUATE

Ron Dorn

GRANTS-IN-AID

HIGH SCHOOL

Paul Smolenyak

BUDGET

Karen Conzelman

BUD ELLIS OUTSTANDING SERVICE AWARD

Gordon Johnson
Bud Ellis
Stephen Williams
Eleanor Davey
Sandra Woodward

FELLOWS, NOMINATING

Vic Baker
Jan Bowers
Owen Davis
Don Post

BEST STUDENT PAPER

Owen Davis

BEST STUDENT POSTER

Owen Davis

REPORT OF THE PRESIDENT

I feel very fortunate to have played some small part in the activities of the Academy this year. My most lasting memories of 2000 - 2001 are those of gratitude for the continued fine service of several of our officers, and of new and vigorous roles played by newer members of the Board of Governors. Betsy Cooper is "retiring" if that word can be used for her continued level of activity, and will "only" be doing one major job for ANAS - Recording Secretary. Karen Conzelman has graciously agreed to continue as Treasurer.

I am particularly grateful for the fantastic job that Ingrid Novodvorsky has done in updating the membership directory. Our mailings are now consistent and efficient, thanks to the database Ingrid maintains.

For me, the core of ANAS is its Journal, and its new editor Tony Brazel has built a firm foundation for its revision. Supported by an editorial board and the *Vascular Plants of Arizona Project Committee* we have two issues this spring, and more to come before the end of the year. Tony deserves a special thanks from all of ANAS.

You may have noticed the increased number of reports in the ANAS Newsletter, so capably edited by Steve Williams. These are being submitted by our Regional Directors, the currently most active Director being Kathy Lauckner, who has planned our meeting at UNLV. This is a tremendous amount of work, and one of the central accomplishments of the Academy.

The Junior Academy is meeting in Glendale this year, with the meeting being planned by Steve Williams, Karen Conzelman, Betsy Cooper, and the Director of the Junior Academy, Lynnette Hoff. I'm sorry they won't be at the Annual Meeting, but I'm grateful to all of these ANAS Officers for their hard work in this area.

I salute the Board of Governors and the Academy for its many accomplishments in 2000-2001, and I urge it to even greater efforts. And I look forward to their replacement! I close with this appeal to the ANAS membership. As good as these officers are they should all be replaced - eventually. I ask you all to consider their welcome efforts of service that make this organization possible, and I ask each of you to consider volunteering to serve in one of the many offices that are currently so ably filled. Do it now. There's work to be done.

Owen Kent Davis
President, ANAS

**Minutes of the 44th Annual Meeting
of the Arizona-Nevada Academy of Sciences
April 15, 2000**

Owen Davis welcomed members of the Academy and Academy Fellows. The minutes of the last Annual Meeting were approved. The reports of the membership committee, President, Permanent Secretary, Treasurer, Fellows committee, and Necrology Committee were approved.

Vic Baker, Jan Bowers, Owen Davis, and Don Post were voted in as Fellows by the membership.

Gordon Johnson reported that the Bud Ellis Scholarship Award is being given to Douglas Jarczok of Ironwood High School. Douglas plans on attending Arizona State University where he will major in chemical engineering.

Gordon Johnson presented the Outstanding Teacher awards to Debbie McWilliams of Coolidge Intermediate School in Coolidge, AZ., Celia Cameron of Buckeye Elementary District #33 in Buckeye, AZ., and Larry Dukerich of Dobson High School in Mesa, AZ.

Recipients of the High School Grants-in-Aid are Bridget Seller and Sarah Gibson. Graduate Grants-in-Aid were awarded this fall to Jeffrey Brasher and Jeffrey Rousch both working at Arizona State University. The spring Graduate Grants-in-Aid were awarded to Joseph Gilbert and Ilsa Schiefelbein both at the University of Nevada, Las Vegas.

Robert Reavis reported that Joy Gillick of the University of Arizona won the Best Poster Award for her presentation on the Hydrogeochemistry of the Rincon Valley, AZ.

Steve Williams presented the Outstanding Service Award to Gordon Johnson for his many years of contribution to the Arizona-Nevada Academy of Science. Gordon has been active in all phases of the society, serving as a Director, President, and Permanent Secretary.

The slate of officers presented by the Nominating Committee was approved. Owen noted that we are in need of a Director for the Central District.

The meeting was adjourned at 12:40.

Respectfully submitted,

Betsy Cooper,
Recording Secretary

REPORT OF THE PERMANENT SECRETARY

I know that I have failed to fill Gordon Johnson's shoes, this year, but I plan to do better, as soon as I leave the Presidency behind me. After filling out the Arizona Corporation Commission Report, everything else seemed positively easy. It's too close to filing an income tax report for my liking. There's also an occasional letter to be answered, and a request to be filled. Although Les Landrum keeps back issues of the Journals, the Permanent Secretary keeps the Academy Archives (including Proceedings Volumes), and I mail a few of those out.

I have taken on the ANAS web site as part the duties of Permanent Secretary. Thank you all for visiting it and suggesting additions and corrections. And, thanks for posting your addresses in the directory. Lots of us use the directory to keep in touch with other Academy Members, and to my knowledge it's not been abused. Please let me know if you suspect otherwise! The URL is <http://geo.arizona.edu/anas/>

I've started an ANAS list server, for those who responded to the initial mailing. The mailings have been few, but feel free to volunteer (non commercial!) information pertaining to science in Arizona and Nevada to anas@geo.arizona.edu.

Owen K. Davis
Permanent Secretary, ANAS

REPORT OF THE FELLOWS COMMITTEE

Based on their standing in the scientific community and service to the Academy, the following members are recommended to be named Fellows of ANAS:

Jeffrey S. Dean, Anthropology, U of A
William A. Longacre, Anthropology, U of A
Laurence E. Stevens, Biology, NAU

ANAS Fellows Committee
Vic Baker
Jan Bowers
Owen Davis
Don Post

REPORT OF THE NOMINATING COMMITTEE

The Nominating Committee submits the following slate of candidates for 2001 - 2002

President	James de Vos
President Elect	Aregai Tecele
Recording Secretary	Betsy Cooper
Membership Secretary	Ingrid Novodvorsky
Treasurer	Karen Conzelman

Directors

Southern Arizona

Owen Davis
Robert Scarborough

Central Arizona

William Perry Baker
Robert Reavis

Northern Arizona

Norman Thomas

Nevada

Kathy Lauckner
Carl L Reiber

Respectfully submitted
Owen Davis
Don Young,
Jim deVos

REPORT OF THE MEMBERSHIP SECRETARY

In January, we mailed membership renewal notices to all the members in our database. As a result of that, we currently have 176 current members from 20 different states. This number includes 67 members who are exempt from dues because of their status (life, emeritus, or honorary). Of the dues-paying members, only four are student members. Thus, perhaps we would like to develop a plan to encourage more of our undergraduate and graduate students to get involved in ANAS.

We set a deadline of March 31, 2001 to receive membership renewals. Those who did not renew by then will be dropped from the active membership database.

Our institutional database includes 52 libraries or other institutions that are current in their subscriptions. These members are from 15 different states and 3 foreign countries (England, Mexico, and Russia).

Respectfully submitted,
Ingrid Novodvorsky

OUTSTANDING SERVICE AWARD COMMITTEE

This year's Outstanding Service Award is being awarded to Edwin Kurtz, a life member of the Arizona Nevada Academy of Sciences. Ed Kurtz was one of the group of Arizona scientists who formed the original Arizona Academy of Sciences. He served as the first corresponding secretary, whose responsibilities then included editing the newsletter and producing the Proceedings as well as maintaining all the correspondence. Ed also served as president of the Academy for two terms. He was instrumental in the development and establishment of the Visiting Scientist Program, one of the early Academy programs sponsored by the National Science Foundation. Dr. Kurtz left Arizona in the early 1960s to become Director of the National Science Foundation. From there he went to Texas Tech University. Upon retirement, he returned to Arizona and now lives in Flagstaff.

OUTSTANDING SCIENCE TEACHER AWARD

Awards are being given to outstanding teachers in two divisions: middle school and high school.

Bonnie Phillips of Cortney Junior High School in Las Vegas, Nevada is receiving the Middle School award.

Megan Chandler of Desert Christian High School in Tucson, Arizona is receiving the High School award.

Respectfully submitted,
William Perry Baker

GRADUATE GRANTS-IN-AID COMMITTEE

Raul Puente-Martinez of the Department of Plant Biology at Arizona State University is being awarded \$250 to support his research on a "Taxonomic Revision and Phylogeny of Nopalea spp (Cactaceae).

Respectfully submitted,
Ron Dorn

HIGH SCHOOL GRANT'S-IN-AID COMMITTEE

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

Laura Ekholm of Mingus Union High School, Arizona is working on a project entitled: "Cleaning Up On Aisle 5". She is working with her teacher Tom Green. In this study, Laura is conducting an analysis of soils contaminated by allegedly illegal dumping.

Kris Garcia and Daniel Marshek of Smith Valley High School, Nevada are working with their teacher Randi Hune to investigate how color influences the feeding behavior of mice.

Samantha Shields of Holbrook High School, Arizona working with her teacher Richard Hurst is making a study of pH and Fertility Differences Between Mount Redoubt Volcanic Ash and Generic Potting Soil.

Respectfully submitted,
Paul Smolenyak

REPORT OF THE BUD ELLIS SCHOLARSHIP AWARD COMMITTEE

The winner of the Bud Ellis Scholarship for 2001 is Eric C. Wu from Ironwood High School in Glendale, Arizona. An exceptional student and leader, Eric plans to attend the University of Arizona, concentrating in molecular approaches to cellular biology, combined with a premedical curriculum.

Respectfully submitted,
Stephen M. Shuster

REPORT OF THE NECROLOGY COMMITTEE

Since our last annual meeting, we have been informed of the passing of one of our long-time members, Lucy May Cranwell:

Dr Lucy May Cranwell MA, DSc, FLS (Lond.), FRSNZ
7 August 1907 - 8 June 2000

Lucy Cranwell was an internationally renowned botanist and palynologist who began her career at the Auckland War Memorial Museum in 1929. She moved to America in 1944, and to Tucson in 1954, where she continued her work on Gondwanan pollen and Hawaiian peat right up until her death of cancer last spring.

Respectfully submitted,
Ingrid Novodvorsky

**TREASURER'S REPORT
2000**

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

Account Value on 12/31/99	\$15,110.63
Transferred to ASU General Fund	-3,000.00
Dividend Deposits	+822.23
Account Value on 12/29/00	\$12,932.86

Goethe Educational Endowment Fund (Vanguard Index 500 Mutual Fund)

Account Value on 12/31/99 (147.222 shares at \$135.33/share)	\$19,923.55
Transferred Donations +1.003 shares	Total: 148.225 shares
Dividends +1.477 shares	Total: 149.702 shares
Account Value on 12/29/00 (149.702 shares at \$121.86/share)	\$18,242.69

General Fund

December 31, 1999 Balance	\$1,409.26
Transferred to Goethe Educational Endowment Fund	-133.00
Deposits	+11,408.00
Expenses	-9,678.66
December 29, 2000 Balance	\$3,005.60

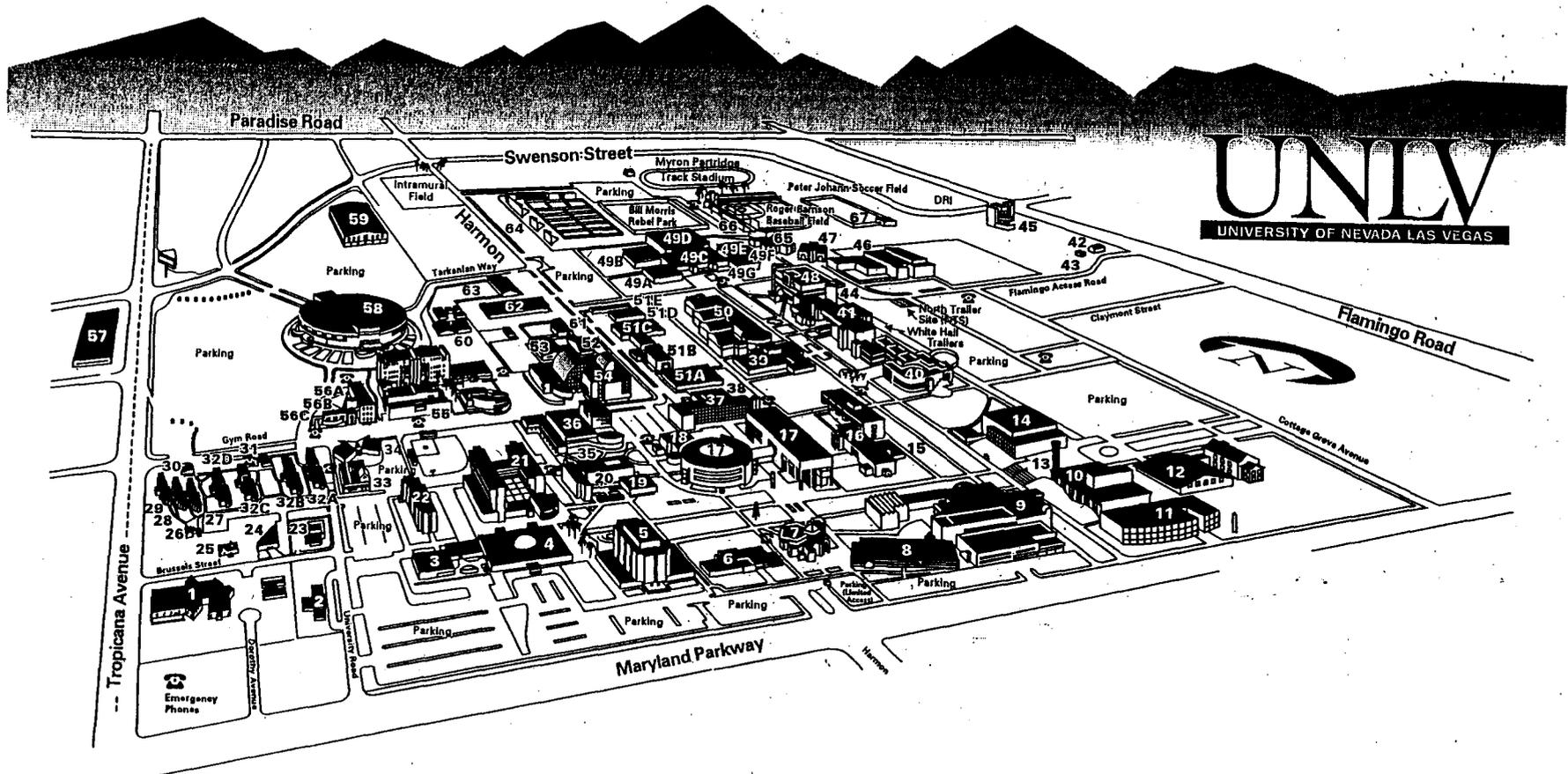
ASU General Fund

December 31, 1999 Balance	\$210.86
Transfer from Short Term Reserve Fund	+3,000.00
Deposits/Credits	+72.85
Expenses	-2,427.16
December 29, 2000 Balance	\$856.55

Market Value of Assets (as of December 29, 2000) \$35,037.70

General Fund Details

<u>Deposits</u>		<u>Expenses</u>
\$3,080.00	Membership dues	
	Journal:	
760.00	Subscriptions	
807.00	Sale of Back Issues	
1,843.00	Reprints/Page Charges	
	Printing	\$2,069.00
	Typing	593.75
	Postage	295.62
	Newsletter:	
	Printing	309.86
	Postage	443.03
	Scholarships:	
400.00	Scholarships	1,200.00
	Committee Expenses/Postage	0.00
	Grants-in-Aid, High School:	
	Grants	200.00
	Printing/Postage	123.78
	Grants-in-Aid, Graduate	1,246.30
	Annual Meeting:	
2,550.00	Registration Fees	
1,850.00	Sponsors donations	
	Proceedings, Printing	642.29
	Coffee Breaks	546.00
	Saturday Luncheon	2,248.75
	Meeting Rooms	170.00
	Awards	
	Outstanding Service	50.00
	Outstanding Teacher	150.00
	Printing/Postage	220.83
	Plaques	77.04
	Best Student Papers	150.00
	Supplies	0.00
	Junior Academy:	
30.00	Registration Fees	
	Luncheon	(included)
	Trophies	350.00
	Call for Papers (Printing and Postage)	0.00
	Proceedings	298.76
	Travel Reimbursement	400.00
88.00	Goethe Endowment Fund Contributions	
	AZ Corporation Commission	10.00
	NAAS Dues	74.05
	Supplies	80.98
72.85	Postage/Office	132.41
	Printing/Office	0.00
	Membership Expenses	23.37
\$11,480.85	TOTALS	\$12,105.82



UNLV
UNIVERSITY OF NEVADA LAS VEGAS

7 - Tam Alumni Center
55 - Classroom Building Complex (CBC)