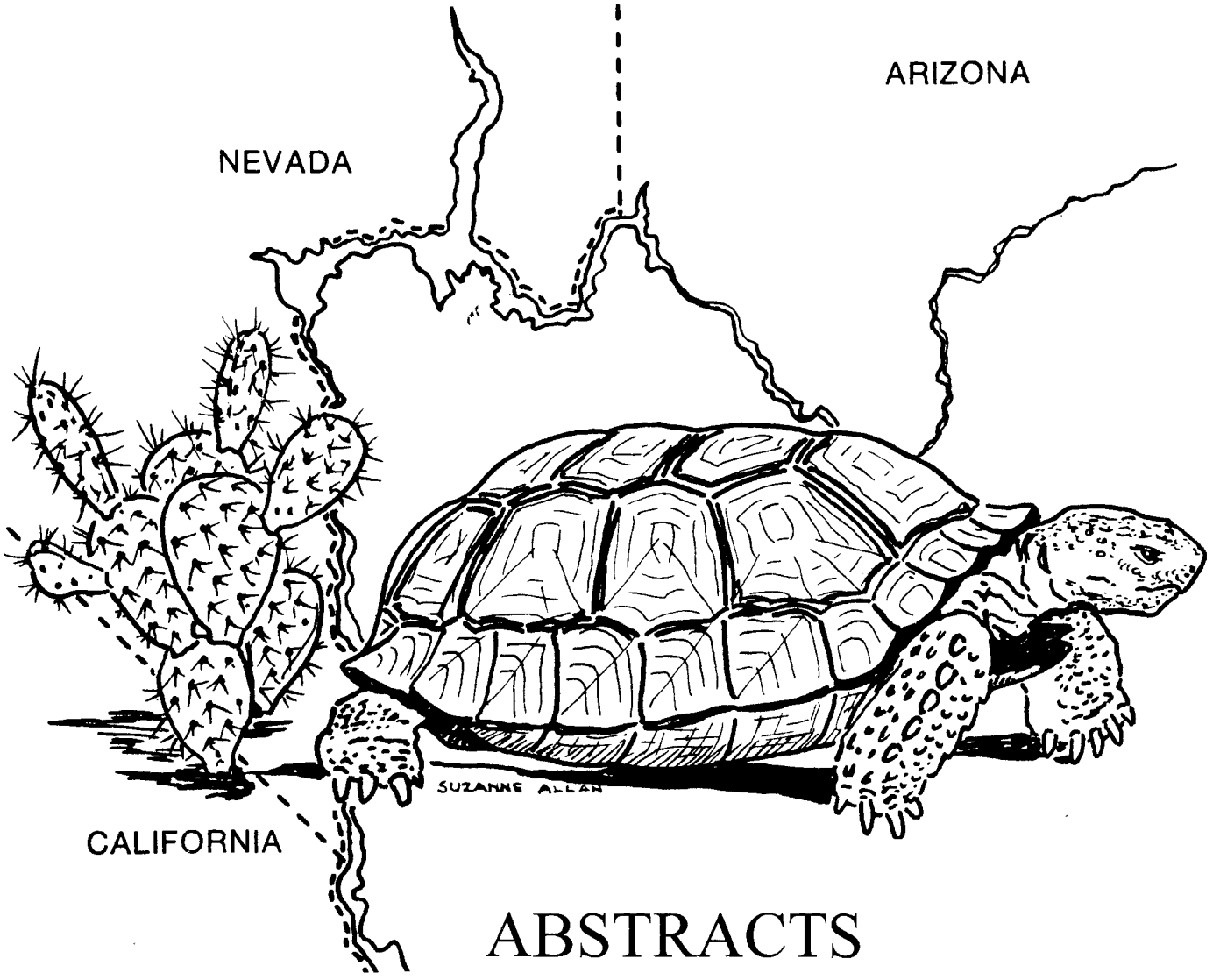
THE

DESERT TORTOISE COUNCIL



ABSTRACTS

34th ANNUAL SYMPOSIUM

February 20–22, 2009

ABSTRACTS

THIRTY-FOURTH ANNUAL MEETING AND SYMPOSIUM
THE DESERT TORTOISE COUNCIL

Casa Blanca Resort and Casino, Mesquite, NV
February 20–22, 2009

(Abstracts arranged alphabetically by last name of first author)
*Speaker, if not the first author listed

Post-fire Plant Recovery and Restoration in the Mojave and Sonoran Deserts of Western North America

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Understanding natural plant recovery following desert wildfires is important for determining habitat suitability for a variety of organisms and for making decisions about active revegetation treatments. This presentation discusses: (1) a systematic literature analysis of studies examining post-fire recovery of perennial vegetation in the Mojave and Sonoran Deserts, (2) examples of augmenting natural establishment through active revegetation, and (3) a synopsis of current work our lab is conducting with the Joint Fire Science Program to understand revegetation and reducing invasibility by exotic annual grasses in the Mojave Desert. Based on the systematic literature analysis, post-fire sprouting by desert perennials is generally limited but varies among species. For example, only 3-37% of *Larrea tridentata* sprouted compared to 64-86% of *Yucca schidigera*. Four of five studies measuring recovery of perennial cover reported close relationships (r^2 = 0.67-0.99) between time since fire (TSF) and total perennial cover. In fact, three studies measuring the longest TSF (≥ 37 years) found that cover had returned to within 10% cover of unburned areas within approximately 40 years. Conversely, post-fire species composition exhibited little convergence with unburned composition in five of six studies even 47 years after fire. *Sphaeralcea ambigua*, *Gutierrezia* spp., *Achnatherum speciosum*, *Encelia* spp., *Hymenoclea salsola*, and *Baileya multiradiata* exhibited the highest burned:unburned abundance ratios, although overall post-fire community composition differed between the Mojave and Sonoran Deserts.

Continuing Efforts to Protect and Recover the Desert Tortoise

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For the last dozen years, the Center for Biological Diversity has focused its desert tortoise conservation and recovery efforts primarily in the California Desert Conservation Area (CDCA) through advocacy, participation in administrative processes and, when necessary, litigation. Through a science-based approach, the Center has supported increased protection for the desert tortoise as a stepping stone towards desperately needed recovery of the species. Habitat protection for desert tortoise also protects innumerable other species, both rare and common that make the iconic western deserts their home. Success in this campaign has changed the dialogue for desert tortoise conservation and resulted in on-the-ground actions such as buy-out and retirement of desert grazing allotments in key tortoise habitat.

We believe that more protection and recovery efforts need to be focused on the desert tortoise because of the continuing population declines. Updates on the current pending legal challenges to the BLM's CDCA plan including ESA challenges to the West Mojave Plan amendment and the Northern and Eastern Colorado plan amendment and the FWS biological opinions BLM has relied on, along with ongoing challenges to grazing lease renewals will be covered. An overview of the failures of the proposed revision of the Desert Tortoise Recovery Plan will be highlighted. The tragic failures of the Fort Irwin "first phase" translocation will be reviewed. Additional updates on other aspects of the Center's desert tortoise conservation strategy will be discussed.

Status of the Desert Tortoise Recovery Plan Revision

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As of the 2008 Desert Tortoise Council Symposium, the Fish and Wildlife Service had made available working drafts of the revised recovery plan for the Mojave population of the desert tortoise for review and comment and had held open houses, meetings, and conference calls to address the most substantive comments. Subsequently, we completed a revised draft of the recovery plan and on August 4, 2008, published a Notice of Availability for public comment in the Federal Register. The public comment period ended on November 3, 2008. Concurrently, we solicited independent peer reviews from six scientists with expertise relevant to various specific aspects of the revised plan. Forty-three comment letters were received from State or Federal agencies, non-governmental organizations, and individuals, not including over 6000 form letters from the internet, and four peer reviewers responded. Among the major comment topics were

the establishment and function of Recovery Implementation Teams and a spatial decision support system, perceptions that recovery actions from the 1994 plan have either been weakened or continued without justification, uncertainty about population augmentation, and questions about recovery unit delineation. Various issues surrounding the recovery objectives and criteria were also noted. Currently, we are addressing the public and peer-review comments and revising the recovery plan in anticipation of final publication in Spring 2009.

Recovery of Annual Plants on an Aqueduct Corridor in the Mojave Desert 36 Years after Disturbance

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We conducted a pilot study to assess recovery of winter annual plants in the right-of-way corridor of the second Los Angeles aqueduct 36 years after its construction. We established transects at four distances from the approximate center of the disturbance corridor: at the verge of the service road or the 0-m distance, at 20-m and 40-m away from the road verge, and at 100 m away in undisturbed vegetation. We recorded 49 species of annual forbs and grasses, of which 43 were native species and six were alien species. Distance from the road verge was an important variable for assessing recovery of annual plants. Alien species composed from 63.3 to 85.6% of the total annual biomass, depending on distance from the road verge. *Schismus* spp had the highest percentages of total biomass, followed by *Bromus rubens* and *Erodium cicutarium*. Native annual plants significantly increased in richness from the road verge to the undisturbed vegetation, but not in abundance, biomass, or cover. In contrast, alien annual plants increased in abundance, biomass, cover and richness with increasing distance from the road verge. The species of shrub and type of canopy cover (live, dead, in the open) also affected the abundance, biomass, and richness of annuals. For example, abundance of native annuals and biomass of alien annuals were higher under the canopy of dead cheese bushes (*Hymenoclea salsola)* than under dead or live rubber rabbitbrush (*Ericameria nauseosa [=Chrysothamnus nauseosus])* at 20-m from the verge. In general, native annuals are closer to achieving recovery or similarity to the undisturbed annual vegetation on the 40 m transects than at the road verge and 20 m transects.

Health and Survival of 158 Tortoises Translocated from Ft. Irwin: Year 1 of the Health Research Program

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Since the late 1980s, new and emerging diseases have been identified as contributors to the decline of some desert tortoise populations. When tortoises are translocated, their health status and overall condition at the time of translocation are likely to be factors influencing later well-being and survival. For the Ft. Irwin Translocation Project, we designed a research project to determine potential effects of translocation on four groups of adult tortoises with differing health status: 1) healthy or control tortoises, without moderate to severe clinical signs of infectious disease, trauma, or shell disease; 2) tortoises with moderate to severe clinical signs of past trauma; 3) tortoises with moderate to severe clinical signs of shell disease; and 4) tortoises with moderate to severe clinical signs of upper respiratory tract disease (URTD), but with negative laboratory tests and no evidence of nasal discharge. We are studying whether or not translocatees in each of the four health categories develop new disease, more severe clinical signs of URTD, more severe cases of shell disease, or new trauma after translocation. Examples of other factors include differences in survivorship and causes of death among tortoises in the four health status categories, and differences in the pathogenesis of mycoplasmosis among size classes and sexes. In the presentation, we summarize the first year of translocation for the 158 tortoises (82 females, 76 males), from late March through December of 2008. In spring, after translocation, 4 of 142 tortoises (2.8%) had positive or suspect ELISA tests for *Mycoplasma agassizii* and 3 tortoises had positive or suspect ELISA tests for *M. testudineum*. In fall, 3 of 111 tortoises (2.7%) had positive or suspect ELISA tests for *M. agassizii,* 1 tortoise had a positive ELISA test for *M. testudineum*, and 34 tortoises had suspect tests for *M. testudineum*. During the first 9 months after translocation, 25.9% of the translocated tortoises died; most deaths were due to predators. In addition to predator kills, one death was due to a vehicle kill, a second death was probably from hyperthermia, and a third death was probably from a rattlesnake strike. A fourth tortoise was salvaged because of disease (gout). Significantly more females than males died. There were no significant differences in mortality between the four health groups. We will be tracking these tortoises for the next few years to determine changes in health status and survival. The findings will be of use to design of future translocation projects.

Comparing Translocation Methods and Effectiveness for Desert Tortoises at Fort Irwin

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The U.S. Army must translocate 1000 to 2000 desert tortoises (*Gopherus agassizii*) in the Mojave Desert to accommodate the expansion of the National Training Center at Fort Irwin. Three research teams are studying various aspects to assess the success of the translocation and its effect on tortoises. Our team is responsible for surveying for tortoises on approximately 335 km^2 and moving 467 from the Southern Expansion Area and an estimated 737 from the Western Expansion Area. We are also comparing different methods of translocation and studying its success. With a study design that includes controls treatments, and replicates, we are tracking a dynamic population of 473 tortoises. Parameters we are measuring include movements, homing, egg production, habitat choice, genetic assimilation, and mortality. A large sample size should provide sufficient power to detect important differences and to provide valuable information to aid future translocations of desert tortoises and other species.

Protecting the Desert Tortoise Rangewide: Recent Efforts by Western Watersheds Project

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Western Watersheds Project (WWP) works to protect and conserve the public lands, wildlife and natural resources of the American West through education, public policy initiatives and litigation.

In October 2008, WWP and WildEarth Guardians petitioned the Secretary of the Interior to list the Sonoran desert tortoise population under the Endangered Species Act. This was prompted by evidence of significant declines in monitored populations of the Sonoran desert tortoise throughout its range in Arizona.

WWP is also engaged in litigation with the Bureau of Land Management (BLM) over cattle grazing on the Sonoran Desert National Monument. This 496,337 acre Monument was designated in January 2001 to protect the area's plants, wildlife, habitats, and cultural resources. The monument includes 25,000 acres of land in the Maricopa Mountains that was designated as "critical habitat" for the Sonoran desert tortoise under the presidential proclamation. The litigation seeks to ensure that the BLM completes the grazing compatibility determination ordered under the 2001 proclamation.

WWP continues its efforts to conserve listed Mojave desert tortoise populations. Recovery measures should be based on best available science. Despite strong evidence of population declines and continuing threats which merit strengthened protection, the USFWS has proposed watering down the recommendations of the 1994 science-based *Desert Tortoise (Mojave Population) Recovery Plan* in its recent draft revision. The proposed draft revised plan fails to address the impact to the different desert tortoise populations in the six recognized Recovery Units of treating the Mojave desert tortoises as a single population for ESA purposes. WWP is working to remedy this situation.

Status and Stewardship of Desert Tortoises in Springdale, Utah

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The desert tortoise (*Gopherus agassizii*) population in Zion National Park and Springdale, Utah, is at the northeastern limit of the range of this species. In response to development on private land in tortoise habitat bordering the park, seven weeks of line transect surveys (March-May 2008) were carried out. Seven tortoises were detected between 5 May and 22 May; one tortoise was detected twice. Two detections occurred on transects, the remainder were opportunistic. Tortoise scats were detected in 26 of 49 (53%) quadrats. Burrows were found in 11 quadrats (22%).

All seven tortoises detected were radio-tagged and monitored. They shared shelters in groups from early June through mid-August, and began grouping again in mid-October. Weekly telemetry monitoring resulted in five observations of untagged tortoises, and 9 September copulation. Telemetry monitoring may be a more effective method than line transect surveys for determining the status of this population.

Over 40 posters and 27 activities were created and presented to the local community in seven educational events. Event messages progressed from generating interest in local desert tortoise population to providing tools for citizens to participate in desert tortoise stewardship. Average attendance was 209 people. Following this educational outreach, the number of tortoise sightings reported by local citizens increased to 5, from 0 reports each year in the past. These reports included the second- and third-ever sightings on the east side of State Route 9 in Springdale. Although unconfirmed, these reports are critical to understanding which parts of Springdale are used by desert tortoises.

Re-establishment of Perennial Plants and Stability on Restored Vehicle Routes in Desert Tortoise Habitat

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Vehicle routes can have enduring effects on the diverse soil and vegetation communities that support desert tortoises. New vehicle routes expand the footprint of access into sensitive areas resulting in damage to burrows and injury to live animals. Routes degrade habitat by encouraging invasive annuals that out-compete native annual species prevalent in tortoise diets and provide fuel for wildfires. Desert lands typically take decades or centuries to recover from disturbance, and land managers often decompact routes and apply surface mulches to accelerate soil and vegetation recovery. We evaluated effectiveness of past rehabilitation treatments across a broad geographic region. We measured perennial plant establishment and site stability, which was defined as increased ground surface structural cover and reduced bare soil cover on the vehicle routes compared to off-route controls. Despite low rainfall during the monitoring period, we documented greater structural cover and lower bare soil cover over the short-term period after vehicle routes were treated. Even though this increase in site stability was primarily a direct result of the mulches added to the treated routes, the greater proportion of live plants on treated routes suggests that enhanced site stability is curtailing plant mortality, likely by mitigating plant moisture stress that prevailed during our two years of monitoring. Even though seedling establishment of Mojave Desert species is typically associated with abundant winter and spring rainfall, the negative relationship between surplus summer rainfall and plant density implies that recruitment events may have been offset by seedling mortality during high-energy surface flows along compacted routes during extreme monsoon storms. The ecologically-based monitoring approach presented here emphasizes the short- and long-term recovery processes that drive vehicle route rehabilitation and can assist in sound management decisions for maintaining suitable habitat for desert tortoises.

Unraveling the Genetic History of Desert Tortoises (*Gopherus agassizii*) in Sonora, Mexico

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A team of Mexican, Canadian and American collaborators has begun an ambitious effort to study Desert Tortoises throughout their range in Mexico. As part of this effort, we are examining the population genetic structure of tortoise populations in

the Sonoran Desert south of the Arizona border. Since 2005, we have collected samples from three main geographic regions in Mexico representing three different vegetation types; 22 samples from two sites near Alamos, Sonora (tropical deciduous forest), 19 samples from two sites near Ciudad Obrégon (foothill thornscrub), and 14 samples from two sites north of Hermosillo (Sonoran desert scrub). We analyzed all samples for 16 STR loci and the mitochondrial ND4 gene. Incorporating samples previously collected in Arizona, we found a continuum of genetic similarity from central Sonora northward spanning 850 km of Sonoran desert scrub, from Hermosillo, Sonora to Kingman, Arizona. However, distinct mtDNA haplotypes at the southern edge of the species range suggest a more complex story in this vegetative transition zone. In foothill thornscrub and tropical deciduous forest in southern Sonora, we found fixed differences in STR alleles, autosomal STR motifs, and mtDNA haplotypes that clearly distinguish a unique, "Sinaloan" *Gopherus*. We estimate this Sinaloan type diverged 5-6 mya from a common ancestor with the Sonoran and Mojave lineages. Spatial overlap of several genotypes at the southern boundary of Sonoran Desert scrub may be the result of a natural species friction zone, human translocation or possibly isolation prior to the formation of the Sonoran Desert.

Genetic Assessment of a Captive Population of Bolson Tortoises (*Gopherus flavomarginatus*) in New Mexico

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In September 2006, 37 Bolson tortoises (*Gopherus flavomarginatus*) were translocated from the Appleton Ranch near Elgin, Arizona to the Armendaris Ranch in New Mexico with the long-term objective of restoring wild populations through captive breeding. We obtained DNA samples from these individuals, wild individuals in Durango, Mexico and from captives at El Paso Zoo. We examined both mtDNA and autosomal microsatellite loci to help inform management decisions for the captive population. Bolson tortoises in the wild have likely undergone tremendous reductions in population size since the last glacial maxim as was evidenced by a general lack of genetic divergence. Fortunately, the Appleton population captures roughly 97.5% of the total genetic diversity that we observed and has high potential for long-term viability with no immediate need for the introduction of new individuals. We make recommendations for captive pairing that maximize genetic diversity and reduce the potential for inbreeding. Our examination of the El Paso Zoo's population as a possible source of breeding individuals was consistent with previous studies that; the El Paso Zoo animals are hybrids with *G. polyphemus*. However, looking to other zoological institutions or private collectors may prove successful as long as appropriate genetic testing is done prior to

breeding. Although we make suggestions for the best possible pairings of individuals based on genetic relatedness, actual pairings will need to consider other factors such as the behavior and history of each individual, as well as the potential for the spread of disease.

Predation and Translocated Desert Tortoises at Ft. Irwin National Training Center: Separating Fact from Fiction

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In 2008, Ft. Irwin National Training Center implemented a desert tortoise translocation project including over 600 tortoises. Tortoises were monitored for up to two years prior to the translocation. In January of 2008 we observed coyote predation on tortoises in the monitoring program after tortoises emerged during a winter rain event, although we did not reach prescribed thresholds for implementing management actions. The translocation occurred on 27 March 2008. Coincident with this we began to observe increased rates of predation on Translocated, Resident, and Control tortoises that appeared to be focused in localized areas. A discussion with scientists and regulators was initiated immediately, and subsequent review of the issue and literature by the Fish and Wildlife Service and the Science Advisory Committee to the Desert Tortoise Recovery Office led to a recommendation not to implement a wide-spread control effort. High predation rates continued into the summer and fall finally dissipated somewhat as tortoises entered the inactive season. We conducted a retrospective analysis of factors related to predation rates on our experimental animals using a variety of environmental and anthropogenic factors including the experimental group, elevation and roughness of the habitat, an index of human population density, distance to urbanization, and the number of road segments near tortoises. Statistical analyses indicated that translocation did not affect a tortoises' probability of succumbing to predation, but proximity to human populations correlated with higher mortality rates, along with some environmental factors. On a larger scale increased predation rates were reported at study sites throughout

the range of the Mojave Desert tortoise, indicating a more widespread phenomenon that may be related to predator-prey dynamics related to drought conditions. This may have been exacerbated in areas with the potential to have increased predator levels due to subsidization (e.g. near human populations). Historically, there have also been many reports of high predation on tortoise populations; collectively, this may indicate that high predation rates may be more common than generally considered and may impact recovery of the tortoise range-wide. This dilemma begs the question, "in the face of current and projected land uses, are wildlands capable of sustaining sensitive species like the desert tortoise in the absence of large-scale husbandry", and "can direct or indirect management actions be used to reduce predator populations?" The coincidence of a widespread and high predation event with the translocation was unfortunate. Contrary to media reports and subsequent popular opinion, there is no evidence that the translocation influenced the high predation rate.

Reining in the Wheels: The Need for Responsible Motorized Recreation Management

Tom Egan
Rangers for Responsible Recreation, sponsored by
Public Employees for Environmental Responsibility

"Unmanaged use of off-road vehicles is a crisis that federal land management agencies are failing to address". This statement by Representative Raul Guijalva opened a 2008 hearing by the U.S. House of Representatives, Natural Resources subcommittee on parks, forests and public lands, relating the increasing problems of off-road vehicle use across the nation. The testimony at this hearing overwhelmingly spelled out the growing severity of this problem on both public and private lands and has prompted follow-up hearings.

Riders who knowingly, or unknowingly, stray off designated trails on public lands and national forests can severely damage wildlife habitat, kill or injure animals, contaminate streams, disturb cultural sites, and create public safety risks. Such vehicle uses can also result in private property trespass and damage; landowner intimidation; as well as public land user conflict. Poorly designed or too extensive route networks are impossible to maintain. Trails burned in by illegal vehicle use are seldom removed effectively and generally serve as a beacon for recurrent illegal vehicle use. Far too often soils eroded by straying wheels become primed for non-native plant growth, drastically changing habitat values and commonly ushering in an increased wildfire frequency. Inappropriate vehicle route designation has contributed to the current crisis; as has not effectively implementing route closures, not monitoring designated route networks, inadequate law enforcement and lax penalties for illegal vehicle use.

The Rangers for Responsible Recreation is a recently formed group of retired land managers and law enforcement rangers that maintain unmanaged off-road vehicle recreation is a primary threat to public and national forest lands: a recreational use impact that is rising in its intensity, frequency and capacity for conflict on adjacent private lands. The Rangers believe that America

needs to come to grips with the burgeoning havoc caused by off-road vehicle use on our public lands, national forests and our adjacent private land communities. The sustainability of our natural resources; landowner rights; our community well-being; and the quality of recreational experiences available to all Americans, are ultimately at risk if we continue to do nothing.

To try and get motorized vehicle use programs for our public lands and national forests back on track, the Rangers have proposed three simple steps: (1) enact penalties that deter; (2) augment law enforcement and monitoring budgets; and (3) end hidden costs to taxpayers.

STUDENT PAPER

A Predictive Habitat Suitability Model as a Conservation Tool for Gila Monsters in Washington County, Utah

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Gila monsters and Desert Tortoise are often sympatric in the Mojave Desert of Southwest Utah and both are facing population declines due in large part to habitat loss associated with the buildup of the city of St. George and surrounding areas. These declines have resulted in the listing of the Desert Tortoise under the ESA and prompted the Utah Division of Wildlife Resources to prepare a Gila Monster Conservation Strategy that identifies habitat associations as an important aspect of their biology that is lacking and needs to be further investigated. We present a Weights-of-Evidence habitat suitability model for Gila monsters in Washington County, Utah, comparing the locations of 230 Gila monster observations with five environmental variables to identify selected habitat features as well as map habitat suitability across the study area. Gila monsters in the study area were associated with elevations between 950m and 1050m, moderate to high topographical complexity, moderate to steep slopes, rock lands and sandy loam soils, and Lower Sonoran Life Zone vegetation. Many large prime and favorable habitat areas are protected in the Red Cliffs Desert Reserve. However, there are many favorable and some prime habitat areas that occur outside the Reserve and are either in the path of development or have already been destroyed. This habitat model provides a useful tool for wildlife managers to consider when planning future research, protecting valuable habitat, and reviewing development plans.

STUDENT PAPER

Seasonal Gila Monster Activity Patterns in Southwest Utah: An Application of Temperature Based Activity Estimation (TBAE)

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Understanding animal activity patterns is a fundamental aspect of biology. The activity patterns of Gila monsters in Southwest Utah are mostly unknown due to their cryptic nature. However, since Gila monsters are ectotherms that spend the majority of their time in stable underground shelters it is possible to estimate their activity based on body temperature fluctuations (Davis et al. 2008). We surgically implanted small temperature sensing data loggers into three radio tracked Gila monsters in spring 2007. Body temperature was recorded once every hour from 1-June, 2007 through 7-May, 2008. Surface activity (including basking) is determined by plotting body temperature versus time and identifying where either a sharp peak or dip in body temperature occurred, indicating that the individual left its underground shelter. Throughout the study Gila monster body temperature ranged from 8.1°C to 35.6°C. The first signs of spring basking occurred in mid-February and by mid-March Gila monsters were either basking or active everyday through the end of recording. During June and early July Gila monster activity was mostly nocturnal with fairly long periods of inactivity up to a week and a half long between active periods. Late July through November saw Gila monsters exhibiting long periods of inactivity up to a few weeks long interspersed by short surface bouts. During the winter Gila monsters were inactive while their body temperatures slowly dropped below 10°C.

WINNER OF THE MORAFKA MEMORIAL RESEARCH AWARD IN 2008

Genetic Diversity and Population Structure of the Texas tortoise (*Gopherus berlandieri*): Implications for Conservation.

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The Texas tortoise (*Gopherus berlandieri*) is a state threatened species in Texas. Expanding agricultural practices and urban development are major causes of habitat loss for *G. berlandieri*. In order to provide genetic data that can inform conservation planning for this species, genetic variation, population structure and its underlying processes were examined in the U.S. populations of *G. berlandieri*. An *a priori* hypothesis for geographic pattern in its genetic structure as shaped by the Nueces River basin was tested. A total of 127 individuals representing nine sampling areas were genotyped for 11 microsatellite loci. Assignment tests, *F*-statistics, and analysis of molecular variance (AMOVA) indicate that *G. berlandieri* forms weak population differentiation into

northern and southern groups with a boundary at southern Duval County. A test of isolation by distance and indirect estimation of *Nm* suggest recent gene flow between two groups. Estimation of the extent of recent migration appears to be complicated by human translocation of the tortoises. A lack of concordance between the detected genetic structure boundary and the Nueces River basin did not support the *a priori* hypothesis. *Gopherus berlandieri* is weakly differentiated due to ongoing migration as evidenced by a pattern of isolation by distance. Given the limited genetic structure and continuous habitat degradation, designation of management units may not be warranted. Conservation efforts rather should emphasize connectivity between the remaining northern and southern occupied habitat to retain the historical genetic diversity.

INVITED SPEAKER

Population- and Community-level Responses of Amphibians and Reptiles to Golf Courses in the Sonoran Desert of Arizona

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In heavily populated areas of Europe and the eastern United States, golf courses have serendipitously become strongholds of biodiversity in a sea of human development. In the western United States, where large tracts of nature remain undeveloped, golf courses may play a similar role in the future, as populations continue to expand. We set out to learn more about how golf courses affect amphibians and reptiles, with the goal of using what we have learned to help ensure that golf courses can support healthy populations and communities in the future. We have conducted multiple studies on reptile response to golf courses, including long-term and ongoing research on Tiger Rattlesnakes living on and adjacent to a golf course and development near Tucson in the Sonoran Desert of southern Arizona. From 2002-2008, we captured over 400 Tiger Rattlesnakes, which we recaptured over 300 times, and we radio tracked over 60 individuals, which we located over 7000 times. We draw on this rich data set to examine various aspects of Tiger Rattlesnake ecology. Specifically, we compare relative abundance, demography, spatial ecology, reproduction, growth, diet, and habitat use of snakes whose home ranges did and did not encompass the golf course. The golf course is dramatically different than surrounding desert areas with regard to water availability, vegetative cover, and prey abundance. Tiger Rattlesnakes have fared better on the golf course so far, but is the golf course really an oasis for Tiger Rattlesnakes, or will it turn out to be a mirage? That is, will the addition of critical resources ultimately result in an ecological trap as snakes are brought into closer contact with increasing numbers of humans while the surrounding development continues to grow? We speculate on this question, and make management recommendations that will hopefully promote coexistence of rattlesnakes and humans, and lead to more wildlife-friendly golf courses.

To examine effects of golf courses on herpetofauna at the community level, we surveyed reptile communities at three desert-style golf courses and in nearby intact desert

terrain near Tucson, Arizona, using visual encounter surveys. We compared relative abundance, composition and diversity of reptile species using species accumulation curves and species similarity indices among golf courses varying in age, between on- and off-course sites, and across wet and dry seasons. Species diversity was highest at the newest golf course relative to nearby desert reference samples and the older golf courses. Species diversity was lowest at the oldest golf course we sampled. Despite lower encounter rates of reptiles off-course than on-course, species accumulated faster, as a function of individuals, off-course because of higher evenness. We found more reptiles per unit effort at the oldest golf course (20 years old) than the other two courses (9 and 4 years old), but species diversity was negatively correlated with golf course age. We discuss many potential factors that could influence reptile community composition on desert golf courses, and we place our results in an applied management context.

I Can't See You: Importance of Deep Permanent Shelters for Desert Tortoises in the Black Mountain Ecosystem of Arizona

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The western slopes of the southern Black Mountains in northwest Arizona contain the largest known concentration of desert tortoises in this hundred sixty-kilometer mountain ecosystem. Although these tortoises are legally designated as Sonoran, mounting genetic evidence indicates this population is predominantly Mojavean. These tortoises endure some of the most extreme summer temperatures in the United States. In nearby Bullhead City, the average maximum July temperature of 44.4°C (high 52.2°C) is second only to the Death Valley region of California (Western Regional Climate Center). A key resource for these tortoises are permanent shelters (i.e. caves) located within incised washes of alluvial fans.

We conducted a two-year telemetry study to investigate shelter use patterns and found tortoises used a higher proportion of deep permanent shelters (≥1.5 meters) during summer (Fisher's exact test, $p = 0.000001$) than other times excluding hibernation during which proportions were similar. Similarly when ground temperatures were above 39.4°C, the critical maximum temperature for desert tortoises (Brattstrom, 1965), a higher proportion of deep permanent shelters were used compared to other observation events (Fisher's exact test, $p = 0.007$) again excluding hibernation. Overall, deep permanent shelters were most commonly used (86% of 333 observations) by tortoises followed by impermanent soil burrows (9%), shallow permanent shelters (4%), and vegetation (1%).

Our results indicate that deep permanent shelters likely play an important role in tortoise survival in this extreme environment. Availability of deep permanent shelters in the

Black Mountain Ecosystem is limited by geology and soil type. Unfortunately, these areas are the most vulnerable to permanent degradation from human impact. All other conservation efforts may prove futile if these easily delineated areas are not preserved.

The Ft. Irwin Translocation Project in 2008: Health, Behavior, and Movements of 158 Translocated Desert Tortoises in the Nine Months after Translocation

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We translocated 158 desert tortoises from Ft. Irwin's Southern Expansion Area (SEA) in spring of 2008 to four study plots located outside the SEA. Tortoises were grouped into one of four health groups, placed on one of the four study lots, and subsequently monitored on a regular basis. Health evaluations, which included length and weight measurements, field observations for clinical signs of disease and trauma, and laboratory testing for disease, were conducted in spring (April 12 to June 10) and fall (September 20 to 29) after translocation. Tortoises experienced significant decreases in weight between spring and fall; the magnitude of weight loss varied significantly among study plots but not among health groups.

We conducted preliminary analyses of movement patterns of translocated tortoises. The distances moved varied significantly among sexes, study plots, and months following translocation, but not among health groups. We also evaluated how far the tortoises dispersed from their release points, fidelity to cover sites, and aberrant behaviors. We present our findings in the context of mortality, differences among sexes, and habitat characteristics. This project will provide useful information for design and management of future translocation projects.

Tortoises Crossing Roads: The Science for the Solution

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Although the physical footprint of the U.S. transportation system is relatively small (<1% of the land area), the impacts that roads have on wildlife extend well beyond the right-of-way. The Arizona Game and Fish Department (AGFD) is currently engaged in a number of research studies designed to evaluate the impacts that roads have on Desert Tortoises and inform the placement and design of crossing structures necessitated by the expanding transportation infrastructure in Arizona. The goals of these studies are to evaluate the direct and indirect impacts of roads, assess tortoise use of existing crossing structures and develop a landscape-level desert tortoise habitat model, all of which will be used to provide guidance to transportation agencies when planning projects in desert tortoise habitat. We will provide an update of our on-going research efforts and

describe the role that research and monitoring have in designing an effective mitigation strategy.

Desert Tortoise Juvenile Hatchery Program at Edwards AFB: an Overview and Update on Program Success

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The desert tortoise (*Gopherus agassizii*) Head Starting Program at Edwards Air Force Base, known as the Juvenile Hatchery at the Edwards Tortoise Study Site (JHETSS), began in 2002 as an adaptive management project to test at what age desert tortoise hatchlings raised in predator exclusion pens can be released into the wild and increase the adult breeding population. The program included a test to determine if supplemental irrigation can accelerate achievement of predator resistant body size by increasing/prolonging food available in the pens. Over the course of the study, paternity of JHETSS neonates was also investigated.

Before 2007, a total of 15 yearling desert tortoises were released at the JHETSS site. Predation as well as additional factors resulted in 100 percent mortality. In the fall of 2007, 32 yearlings were released, 16 near the JHETSS site and 16 at a distant location of similar habitat to test if the JHETSS pens are affecting survivorship of released yearlings. The JHETSS pens seem to have become attractive sites for predators, and may be having a negative effect on the tortoise survivorship; to date, only 1 of the 32 animals remains, at the remote location. In the fall of 2008, we selected two remote sites, of different substrates, away from the pens and released fifteen 2-year-old animals, 8 at the first site and 7 at the second site. One location is on a south-facing slope of a small rocky hillside while the second location is on fairly flat topography in a sandy loam substrate. Both sites are in creosote bush scrub. During the follow-up of this release, we will be looking at whether there are any differences in survivorship between these two release sites. No results are available at this time for the 2008 release. Juveniles in irrigated pens have tripled in size compared to the juveniles in the non-irrigated pens. The paternity test confirmed that at least 8 of the 11 clutches involved multiple paternities.

Desert Tortoise Conservation, Research and Outreach: Department of Defense in 2008

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In addition to our military missions, our installations also initiated and continued many conservation, research and outreach programs for the desert tortoise, *Gopherus agassizii*, in 2008. Conservation measures covered a broad spectrum at each installation, ranging from alerting and educating personnel of desert tortoise biology and conservation, to vulnerability assessments and cleaning of ranges. Our installations also participated in the Desert Managers Group, associated workgroups, and the Desert Tortoise Management Oversight Group, to support recovery planning and action. Numerous projects have applications within installations and significant ramifications for tortoises outside installation borders. Some of our programs have broad-reaching consequences that address basic and applied research. These include, among others, health and disease assessments, population monitoring and demographic analyses, predator research, headstarting, genetics and autecology. The effectiveness of our efforts is supplemented significantly through public awareness and outreach initiatives; these efforts range from educating elementary school children to supporting public service announcements and sponsoring Earth Day Activities. These efforts demand significant person power within our environmental offices and our commands. Yet we support these efforts to contribute toward species recovery.

POSTER

Fire Effects on Vegetation in Desert Tortoise Habitat in the Northeastern Mojave Desert: Interim Results from Field Sampling in 2008

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The Southern Nevada Complex fires during summer 2005 burned over 597,000 acres in southern Lincoln County, NV, including over 220,000 acres of desert tortoise (*Gopherus agassizii*) habitat. During March – September 2008, we assessed vegetation characteristics at 25 burned and 28 unburned sites throughout this region. We measured shrub and herbaceous density, species richness, gap intercept, line-point intercept, and herbaceous production at each of the 53 sites during Mar-Apr, May-Jun and Aug-Sep,

corresponding with early, middle and late times of the activity season of desert tortoises. In burned sites, shrub canopy cover was lower and the gaps between canopies were greater. Although similar in species richness, the density of plant species differed between burned and unburned sites. The exotic annual grasses *Bromus* spp. and *Schismus barbatus* occurred in both types of sites and in higher densities in unburned sites, and we found the exotic forb *Erodium cicutarium* in higher densities in burned sites. The comparative densities of native forb species varied between burned and unburned sites. While forage for desert tortoises was available in burned and unburned regions of their habitat in southern Lincoln County, forage composition differed and cover was reduced in areas affected by fire.

Evidence for the Pathogenicity of *Mycoplasma testudineum* in Free-ranging Desert Tortoises, *Gopherus agassizii*

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This study involved the clinico-pathological evaluation of nine desert tortoises (*Gopherus agassizii)* that were a part of a tranlsocation project from a military base in southern, California, USA, to adjoining land. The tortoises were selected for necropsy due to their *Mycoplasma* serological status (indicating exposure to either *M. testudineum* or both *M. agassizii* and *M. testudineum*) and/or clinical signs (palpebral edema, superocular edema, perinasal exuate, and nasal discharge) seen in the field. Of the nine tortoises that were blood sampled at the University of Florida, seven were seropositive for exposure to *M. testudineum* and two were seropositive for exposure to both *M. agassizii* and *M. testudineum.* Of these seropositive tortoises, *M. testudineum* was amplified by PCR and DNA fingerprinted from a nasal lavage specimen of one tortoise and a nasal cavity swab from a second tortoise. *M. agassizii* was not isolated nor identified by PCR from any of the tortoise samples. Of the nine tortoises that were either seropositive for exposure to *M. testudineum,* or both *M. agassizii* and *M. testudineum,* light microscopic evaluations revealed from mild to severe pathological changes in either one or both nasal cavities. While the pathogenicity of *M. testudineum* has not been experimentally studied in desert tortoises, here we present evidence supporting *M. testudineum* as a pathogen in desert tortoises.

The Arizona Game and Fish Department's Turtles Project

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During 2008, The Arizona Game and Fish Department's Turtles Project continued to focus its efforts on conservation and management of Arizona's chelonian species. For the desert tortoise (*Gopherus agassizii*), these efforts included monitoring of wild populations through mark-recapture studies on long-term monitoring and study plots. We worked with the Department's Research Branch conducting radio-telemetry studies to determine efficacy of mitigation measures, movement of tortoises along proposed re-routing of US 95, and to determine habitat and shelter preferences on the west side of the Black Mountains; together we also initiated a study to determine the impact of illegal collection of desert tortoises along multiple-use unpaved roads and trails. In addition, we continued to work with cooperators to develop a statewide monitoring strategy, a protocol for future desert tortoise translocations within the Arizona Strip, and towards finalizing the Arizona Interagency Desert Tortoise Team's State Conservation Agreement for the Sonoran Population of the Desert Tortoise. To better manage the captive desert tortoise population in Arizona, we implementing changes to the Tortoise Adoption Program Guidelines that included a more rigorous pre-adoption screening and limiting adoption to one per household. Our outreach efforts were also greatly improved through the completion and distribution of our desert tortoise poster and tortoise adoption brochures, as well as updating our website to include information on conservation and management of all turtle species in Arizona.

Busy Time for the Desert Tortoise: BLM's California Desert District Report

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The past year has seen extensive interagency coordination with respect to planning for the future of the desert tortoise.

The revised Recovery Plan is being reviewed by the public. In 2008, the California Desert District met with the Desert Tortoise Recovery Office of the Fish and Wildlife Service to coordinate comments on the plan for the California conservation areas and to ensure consistency among the four affected states. California also discussed the plan with the Washington Office of BLM regarding policy issues concerning critical habitat, recovery units and the sustainability of the conservation areas.

The Washington Office of BLM has initiated a major contract to perform in-depth studies of two conservation areas to kick start the Recovery Implementation Teams.

The Marine Corps wants to expand into desert tortoise habitat north, east and west of Twentynine Palms. The Barstow Field Office is coordinating comments from the public on the expansion and is participating in the preparation of an Environmental Impact Statement for this potential land transfer.

Renewable energy companies continue to apply for California desert lands to build wind and solar projects within desert tortoise habitat. Several solar energy companies have withdrawn their requests and BLM has denied seven applications near Ridgecrest. A similar pattern has emerged for wind energy projects near Barstow. New proposals are still being received for both wind and solar projects.

The Barstow Field Office is assessing the translocation of hundreds of desert tortoises from Fort Irwin. Revisions to the existing translocation plan are under review, with a goal of reducing predation and preventing the spread of disease. BLM is also discussing relocation of desert tortoises from many proposed solar energy developments.

Many large-scale desert tortoise surveys have been completed or will be performed in 2009. The data will help validate the USGS tortoise habitat model and the new FWS survey protocol.

Fine-scale Landscape Genetic Structure of Desert tortoises at Ft. Irwin

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Desert tortoises may exhibit genetic structure across large geographic regions as a result of limited dispersal capabilities. At a local scale, tortoises may not be limited by dispersal potential; however, features of the landscape and/or behavioral patterns may influence the movement of desert tortoises over short distances. In order to investigate patterns of genetic structure and gene flow in desert tortoises at a local scale, we undertook a genetic assessment of the local desert tortoise population within and surrounding the U.S. Army's National Training Center at Ft. Irwin, CA. We genotyped nearly 1000 desert tortoises at 16 microsatellite loci, and collected GPS coordinates for each individual. Our suite of microsatellite markers provided us with the power to distinguish individual tortoises and look at fine-scale patterns of genetic structure and relatedness across the study area. Preliminary analysis of our data indicate a weak genetic separation between eastern and western desert tortoise populations within the study area, and suggest that gene flow between these areas is restricted. By combining traditional population genetic analyses with recently developed spatial genetic

algorithms, we were able to coordinate genetic and landscape data into a comprehensive model to infer ecological barriers to dispersal in desert tortoise populations.

The Effects of Dogs on Wildlife Communities

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Domestic dogs (*Canis familiaris*) are frequent visitors to protected areas, but little is known about how they affect wildlife communities. We studied the effects of dogs on wildlife communities by comparing the activity levels of wildlife in areas that prohibited dogs with areas that allowed dogs. We measured wildlife activity on trails and up to 200 m away from trails using five methods: (1) pellet plots, (2) track plates, (3) remote triggered cameras, (4) on-trail scat surveys, and (5) mapping prairie dog (*Cynomys ludovicianus*) burrow locations. The presence of dogs along recreational trails correlated with altered patterns of habitat utilization by several species. Mule deer (*Odocoileus hemionus*) activity was significantly lower within 100 m of trails in areas that allowed dogs than in areas that prohibited dogs. Small mammals, including squirrels (*Sciurus* spp.) and rabbits (*Sylvilagus* spp.), also exhibited reduced levels of activity within 50 m of trails in areas that allowed dogs when compared with areas without. The density of prairie dog burrows was lower within 25 m of trails in areas that allowed dogs. The presence of dogs also affected carnivore activity. Bobcat (*Felis rufus*) detections were lower in areas that allowed dogs, and red fox (*Vulpes vulpes*) detections were higher. These findings have implications for the management of natural areas, particularly those that allow dogs to be off-leash.

Lenth, B.E., R.L. Knight, and M.E. Brennan. 2008. The effects of dogs on wildlife communities. Natural Areas Journal 28:218-227.

Development of an Epidemiological Model of Upper Respiratory Tract Disease (Mycoplasmosis) in Desert Tortoises Using the Daggett Study Area: Year 2, 2008

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The Daggett Epidemiology of Upper Respiratory Tract Disease project has completed its second year. Funded by Ft. Irwin as supporting research for the Ft. Irwin Translocation Plan, the project was designed to quantify the disease dynamics of an on-going epidemic while developing a landscape epidemiology risk model that could be applied to future translocation efforts. During fieldwork in 2008, we conducted 197 health evaluations for clinical signs of disease. We successfully obtained 196 blood samples: 92 in spring and 104 in fall. The samples were collected from 123 individuals located in the three major search bands (core, middle and outer) that were established in

2007. We located and attached radio transmitters to 52 tortoises to replace dead and missing individuals and for a secondary study on the effects of season on titer levels for ELISA tests for *Mycoplasma agassizii* and *M. testudineum*. Ten, 100-m transect surveys were also conducted throughout the plot for perennial and annual vegetation: three in both the core and middle bands and four in the outer band.

Tortoises were evaluated for health in spring and fall. Using the ELISA test for *M. agassizii*, 21.7% and 25.0% of the tortoises were positive or suspect in spring and fall, respectively. Likewise, 16.3% and 45.2% of tortoises sampled in spring and fall, respectively, were ELISA positive or suspect for *M. testudineum*. The spatial distribution of *M. agassizii* and *M. testudineum* was band dependent. Tortoises with positive and suspect *M. agassizii* ELISA tests were predominantly in the core in spring ($p<0.001$) and fall ($p<0.001$). Tortoises with positive and suspect *M. testudineum* tests were present in all bands, but primarily in the middle and core bands in spring ($p<0.05$) and fall ($p\leq0.001$). Mammalian carnivores have been present on the plot and have preyed on tortoises. From the beginning of the project, 136 tortoises have been transmittered. Of the 136 tortoises, 96 are currently alive, 32 are dead, 7 are missing and 1 was salvaged for necropsy. Predators have been responsible for many of the deaths. Forty-nine tortoises from the original 80 are still alive.

The heterogeneous nature of the Daggett study plot creates an opportunity to compare differences in abiotic and biotic attributes from a single location. Furthermore, the opportunity also exists to understand how the variability in these features affects the spatial distribution and transmission of disease. The overall goal of the project is to develop a risk model. Future analyses are proposed to quantify additional abiotic (topography, surficial geology, man-made obstructions) and biotic (home range, contact rates, past population demographics) variables that can be included in this model. The incorporation of one or more of these variables will improve the ability of a risk model to predict the potential for disease outbreaks in tortoise populations and ultimately contribute to recovery efforts for the Mojave population.

Management of Desert Tortoise Habitat on Bureau of Land Management Administered Lands in Nevada

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The BLM administers approximately 4.5 million acres of desert tortoise habitat in Clark, Lincoln, and Nye counties in Nevada out of the Battle Mountain, Ely, and Southern Nevada district offices. 1,085,000 of these acres are designated as Critical Habitat. The following are highlights from BLM's 2008 accomplishments. The Record of Decision for the Ely District Resource Management Plan (RMP) was signed in August 2008. BLM continued its efforts to establish a 20-year mineral withdrawal on approximately 944,343 acres within Areas of Critical Environmental Concern (ACECs) in Clark and Nye counties and received a 2-year extension to prepare the application and

environmental assessment. Section 7 consultation remains a major work load for the Districts. BLM continues to implement the strategies outlined in our land use plans to minimize and mitigate impacts resulting from land use authorizations for energy facilities and corridors, land sales, and other human demands on the public lands. The BLM continues to implement recovery actions including: monitoring 53 locations for desert tortoise habitat conditions and desert tortoise populations in Lincoln County; decommissioning roads and restoring habitat over 20 miles of roads in Gold Butte; installing post and cable fencing at numerous locations that were being continually disturbed by motorized vehicles; and implementing the route designation decision in northeastern Clark County. Wildfires in desert tortoise habitat will continue to receive priority response, emergency stabilization, and restoration plans developed to rehabilitate the area as quickly as possible. The BLM is continuing monitoring of post-fire vegetation treatments.

The Desert Tortoise Preserve Committee's Accomplishments in 2008 and Goals for 2009

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During 2008, the Desert Tortoise Preserve Committee (DTPC) continued efforts to acquire and manage habitat for the desert tortoise (*Gopherus agassizii*), Mohave ground squirrel (*Spermophilus mohavensis*) and Burrowing Owl (*Athene cunicularia*) with the focus on three areas in California: the Desert Tortoise Research Natural Area (DTRNA) in the west Mojave Desert, Pilot Knob in the Central Mojave, and the Chuckwalla Bench in the Eastern Colorado Desert. This year the DTPC accomplished the long-time goal of fencing the entrance of the DTRNA. The land was showing signs of increasing use by OHV recreationists, such as damaged vegetation, the creation of a small network of trails, and compacted soil. In 2008, the DTPC acquired approximately 430 acres of habitat to enlarge the DTRNA and conserve the unique habitat of Harper Dry Lake. The spring of 2008 marked the 20th consecutive year the DTPC, with the support of the Bureau of Land Management, staffed an Interpretive Naturalist at the DTRNA. The well documented trend of increasing OHV use will be discussed within a 20 year framework.

WINNER OF THE MORAFKA MEMORIAL RESEARCH AWARD IN 2008

The On-Going Restoration of Land Highly Impacted by OHV Recreation

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In 2007, the Desert Tortoise Preserve Committee (DTPC) began a restoration project in the eastern expansion area of the Desert Tortoise Research Natural Area (DTRNA). Locally known as Camp "C," the 32 acre area was a gift from the Center of Biological Diversity. The land was heavily used by OHV recreationists, and much of the habitat is denuded of vegetation and has highly compacted soils. Camp "C" was completely enclosed by 1.3 miles of fencing in 2007. The DTPC initiated a restoration plan for Camp "C" in December of the same year in cooperation with the Natural Resources Conservation Service. This restoration plan will be implemented in five acre increments and will be monitored over time. Two different restoration methods were applied for the first five acres of restoration: the creation of micro-catchment islands and the installation of vertical mulch on existing coppice mounds. Micro-catchment islands and coppice mounds were randomly treated with an existing on-site seed bank or were seeded with a known number of seeds collected from neighboring locations. The success of these different treatments and the status of the additional 5 acres of restoration with support funding supplied the David J. Morafka Memorial Research Award will be discussed.

Demographics of a Desert Tortoise Population at Tonto National Forest

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The Turtles Project of the Arizona Game and Fish Department surveyed the desert tortoise population near Sugarloaf Mountain, Tonto National Forest from 2006-2008. Over 680 person-hours were spent surveying for tortoises during 8 surveys, with 43 tortoises found in 68 total encounters. There was no correlation between the number of surveyors and the number of tortoises encountered ($R^2 = 0.03$, $p = 0.66$). There was also no correlation between daily rainfall, maximum daily temperature, and maximum daily humidity with catch-per-unit-effort ($R^2 = 0.60$, $p = 0.25$). Average mean carapace length did not differ between sexes for all years ($p > 0.05$). Males and females were equally likely to be encountered active versus inactive ($p = 0.78$), and were encountered in shelters in 58% and 60% of observations, respectively. More females were encountered than males, possibly suggesting a skewed sex ratio $p = 0.05$). Average tortoise home range size was 1.53 hectares, and average distance moved between survey locations was 127 meters. Males moved farther than females between consecutive encounters ($p = 0.0008$). The population appears healthy, only 2 tortoises exhibited swollen eyelids; 2 other tortoises were found dead, with no evidence of trauma. Using a Pollock's robust

design model, survivorship of adult tortoises in this population during the 3 survey years was estimated at 98%. These surveys and long-term monitoring efforts at this site suggest that this population is stable and free of upper respiratory tract disease.

An Update on USGS Desert Tortoise Research

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The goal of the United States Department of Interior - Geological Survey (USGS) scientists is to provide reliable, high quality scientific information to resource managers to support sound management decisions. The Western Ecological Research Center of USGS contributes to the recovery of tortoises by conducting research aimed at describing ecological patterns, processes and mechanisms, and by providing technical assistance to resource managers. Current research on desert tortoises includes 1) studies of tortoise health/disease and stress levels for the Fort Irwin translocation project; 2) epidemiology of Upper Respiratory Tract Disease at Daggett; 3) long-term demography studies in California with emphasis on causes of death and mortality rates; 4) the effects of fire and post-fire restoration techniques on desert tortoises and their habitat; and 5) desert tortoise habitat modeling. Ongoing technical assistance includes workshops to teach proper blood sampling and handling techniques as well as methods to age tortoises and identify causes of death in the field. The Western Ecological Research Center website at www.werc.usgs.gov provides information on on-going studies in our Center and recent publications by our scientists. Publication briefs, which are one page summaries of peer-reviewed publications and include management implications of research findings, can be found at www.werc.usgs.gov/pubbriefs/.

Assessing Extinction Risk for the Desert Tortoise in Arizona Based on Female Survival

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To determine the current status of desert tortoises in the Sonoran Desert, Arizona, much emphasis has been placed on tracking temporal trends in population estimates across diverse habitats and changing monitoring protocols. Using mark-recapture data collected on 15 long-term monitoring plots, I took a demographic approach to assess extinction risk based on female survivorship and fecundity. Only two of the populations modeled exhibited risk for extinction. In both populations, extinction probabilities were less than 50% (0.06, 0.49 respectively). Both at risk populations exhibited low female survivorship. Extinction risk increased to include 6 populations when fecundity was halved, and extinction probabilities ranged from 0.01 to 1.00. Demographically, desert tortoises are a species that live close to carrying capacity, and exhibit high adult

survivorship, with low annual fecundity, but a very long reproductive lifespan. In turn, populations are sensitive to decreases in female survival and fecundity. While populations may currently seem stable, management efforts should focus on synergistic threats which negatively effect survival and fecundity.

The Redcliffs Desert Reserve—An Important Part of the Tortoise Preservation Puzzle

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Red Cliffs Desert Reserve, Washington County, Utah

The Red Cliffs Desert Reserve established in 1996, in Washington County, Utah , has made significant contributions in protecting tortoises and other sensitive species. This collaborative partnership continues to be a viable and important bridge between protection and development interests. This report will present a status review of accomplishments in 2008 highlighting significant events affecting the Reserve. Information concerning economic impacts, land issues including acquisition, recreation and its impacts on habitat preservation and wildlife conservation will be emphasized. We will also take a look at the road ahead in regards to the National Conservation Area (NCA) status for the Red Cliffs Desert Reserve.

DESERT MANAGERS GROUP

Russell Scofield, Coordinator, Department of the Interior

California Desert Managers Group, P. O. Box 2005, Yucca Valley, CA 92286

The Desert Managers Group (DMG), an organization of federal, state, and county land managing agencies in the California deserts, focuses on coordinating and integrating desert tortoise recovery actions and monitoring efforts among managers and scientists across jurisdictional boundaries. A key to desert tortoise recovery is an informed public that understands and appreciates desert tortoise recovery. Now in its third year, the DMG is implementing an interagency desert tortoise education program targeting desert users and the public. Some goals of the program include standards based environmental education, brochures targeting specific audiences or topics, media releases, public attitude surveys. The DMG is also coordinating several conservation land acquisition programs to achieve the best benefit for resources. Lastly, DMG is coordinating renewable energy development within the California deserts.

INVITED GUEST AND STUDENT PAPER

Evaluating the Impacts of Human Disturbance on Endangered Chelonians, with Focus on the Yellow-blotched Sawback (*Graptemys flavimaculata*) of the Pascagoula River System, MS, USA

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The role of human disturbance and its impact on turtles has been largely neglected except for a few recent studies (Burger and Garber 1995, Garber and Burger 1995, Moore and Seigel 2006). Additionally, virtually nothing is known about the behavioral and physiological response of turtles to these likely novel 'stressors' (i.e. recreational boating, off-road vehicle use). The yellow-blotched sawback (*Graptemys flavimaculata*) is an endangered, riverine turtle that is endemic to the Pascagoula River and its tributaries of south Mississippi (U.S.A.). The largest populations of *G. flavimaculata* occur in the Lower Pascagoula River (USFWS 1991), and it is most commonly observed in riverine habitats basking on fallen deadwood snags. Aerial basking is critical for many species of turtles to maintain many physiological activities (Boyer 1965), including metabolism (Moll and Legler 1971), vitamin K synthesis (Pritchard and Greenhood 1968), shell conditioning (W. Selman, pers. obs.), removal of ectoparasites (Cagle 1950, Neill and Allen 1954, Vogt 1979, Selman et al. 2008), and reproductive function (Hammond et al. 1988). Therefore, we wanted to determine what impact, if any, does recreational boating have on basking behavior and shell conditioning of *G. flavimaculata*. Observations of *G. flavimaculata* basking behavior were made at two sites: Leaf River (recreationally undisturbed) and Lower Pascagoula River (recreationally disturbed). Basking observations were made of individual *G. flavimaculata* males and females at both sites, as well as monitoring hourly basking frequencies at both sites. Human recreational disturbance was also monitored at both sites to determine its frequency and impact on basking behavior. In addition to observations, shell condition of trapped turtles was also assessed at both sites for the presence of shell fungus underneath unshed carapace/plastral scutes. *G. flavimaculata* basked for significantly shorter durations at the Lower Pascagoula River site (disturbed) in comparison to the Leaf River site (undisturbed). *G. flavimaculata* at the Leaf River site exhibited a bimodal basking frequency for both sexes with similar basking peaks during the midday and late afternoon, whereas *G. flavimaculata* at the Lower Pascagoula River site exhibited a different basking frequency with only a slightly higher peak in the late afternoon (after most boat traffic had ceased) after peak sunlight hours. *G. flavimaculata* from the Lower Pascagoula River are 17 times more likely to be disturbed by human recreation in comparison to turtles at the Leaf River site. Slower and larger boats disturbed a significantly higher percentage of basking *G. flavimaculata*, either by visual disturbance or by wake action. Turtles from the Lower Pascagoula site had substantially more shell irregularities than the Leaf River turtles, potentially due to the inability of turtles to bask for desired lengths because of recreational disturbance. Therefore, we suggest that human recreational disturbance is directly impacting turtle basking behavior and likely impacting other physiological processes that are directly linked to aerial basking (i.e. shell condition, long-term stress levels, sex hormone levels).

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Clark County Multiple Species Habitat Conservation Plan

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While the Clark County Multiple Species Habitat Conservation Plan (MSHCP) was not formally approved until 2001, Clark County, the cities of Boulder City, Henderson, Las Vegas, Mesquite and North Las Vegas, and the Nevada Department of Transportation (Permittees), have been engaged in ecosystem-based habitat conservation planning and implementation for nearly two decades. Since the MSHCP and incidental take permit were approved in February 2001, the Permittees have developed more than 76,000 acres of the 145,000 acres authorized for take. To offset this take, the Permittees have committed more than $77 million towards conservation projects in Clark County for

the long-term conservation of 78 covered species - more than 3 times the minimum required by the MSHCP and the Permit - vastly exceeding the expectations originally envisioned for the program's first eight years. As a result, the Permittees have been able to expend more on conservation projects in the first eight years than the minimum required for the thirty year life of the plan. As a result, the Permittees and the U.S. Fish and Wildlife Service have built a strong foundation for species conservation as we move towards permit amendment.

POSTER

Status and Distribution of the Bolson Tortoise in Mexico in 2008

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The Bolson tortoise (*Gopherus flavomarginatus*), a CITES Appendix I Endangered Species, occurs in the southern Chihuahuan Desert of the northern Mexican states of Chihuahua, Durango and Coahuila in the Reserva de la Biosfera de Mapimi which was created in 1977. Recently discovered in 1959, the distribution of this largest species of *Gopherus* is limited to edges of Pleistocene lakebeds in an area of less than 500,000 hectares. Population estimates range from 5,000 to 10,000 tortoises. The most recent published survey data was collected in 1984 and later published in 1988. Since then no extensive surveys of the tortoise's range, distribution and current status have taken place. This poster will present in a geographical format the known range and distribution of the species as it was understood in 1988, along with data collected as recently as 2007.

Hard Times and Slow Breeders: A Private Lands Perspective on Tortoise Conservation

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As the world's economy worsens, money for conservation will continue to dwindle. At the same time, to meet the needs of increasing human numbers and per-capita consumption, management of land for human sustenance will intensify. Given these trends, restoration of slow-breeding species such as tortoises will face increasing challenges. The Turner Endangered Species Fund (TESF) has initiated a project to restore bolson tortoises to Turner-owned properties in New Mexico. As with other protected areas worldwide, these lands are not totally immune to long-term fallout from human

economic and population dilemmas. Where should funding best be applied now to restore tortoises in the uncertain future? One of the TESF's present priorities is to produce young from the <10 captive breeding females and bring them through the well-known "bottleneck" of early-age survival. This effort is greatly aided by the Living Desert Zoo and Gardens State Park (Living Desert) near Carlsbad, New Mexico. On Turner ranches the TESF has constructed egg-laying and headstart facilities and is building an additional facility. Forty-eight young (<3 years old) are presently being husbanded by the TESF and the Living Desert. Within 6-8 years we plan to begin experimentally releasing some of the young into the wild. Conservation education and the dissemination of scientific information are important priorities of the overall effort. Consistent with the principles of adaptive management, we remain open to changes in priority given looming political, social, and climatic changes more drastic than many conservationists might have imagined a few decades ago.

Patterns of Shrub Regeneration Along the Los Angeles Aqueduct, Kern County, California, 36 years After Disturbance

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Efforts to recover vegetation at disturbed sites in the Mojave Desert are increasing as the pace of development on public lands increases. However, the history of concerted vegetation restoration in the Mojave Desert is short (< 50 years), and documentation of restoration projects over decades is generally not available. One exception is vegetation restoration undertaken by a team of plant ecologists from the University of California at Davis in the late 1960s to early 1970s along the length of the second barrel of the Los Angeles Aqueduct and completed in 1972. Shortly after the aqueduct was completed, the soil was ripped to create more microsites for germination of seeds.

We collected data on shrub locations and their canopies to evaluate the spatial arrangement of natural revegetation along one 1-km long straight stretch of the utility road, which bisects the original linear disturbance created by aqueduct construction. The site has uniform leveled topography. We measured vegetation at 0 m, 20 m, 40 m, and 100 m (undisturbed) from the utility road edge.

Key Findings:
(1) Species diversity was lowest along the edge of the utility road (0 m), where rubber rabbitbrush (*Ericameria nauseosa*) predominated.
(2) Cover of *E. nauseosa* significantly declined with increasing distance from the road edge; *E. nauseosa* was not present in undisturbed vegetation.
(3) Canopy dieback in regenerating vegetation (at 0, 20, and 40 m) was significantly lower than dieback in undisturbed vegetation (100 m); the lowest amount of canopy dieback was in the *E. nauseosa*-dominated road edge (0-m).

(4) Canopy cover was statistically significantly different only between the disturbed plots adjacent to undisturbed vegetation (40 m) and the undisturbed plots (100 m).
(5) Creosote bush (*Larrea tridentata*) regeneration was present only in plots immediately adjacent (40 m) to undisturbed vegetation, whereas burrobrush (*Ambrosia dumosa*), the other co-dominant shrub in undisturbed vegetation, was spreading widely (at 20 m and 40 m) but not at the road edge (0 m).

Implications for Restoration Management:
(1) After 36 years, the original goal of re-establishing cover of native shrubs has succeeded. However, the composition of the regenerated vegetation may not meet current and more complex restoration objectives (e.g., for wildlife habitat enhancement).
(2) Seeding or planting of creosote bushes may be needed to restore natural composition to vegetation, particularly next to well-traveled roads.
(3) Winterfat (*Krashnininkovia lanata*) found in undisturbed vegetation was noted only as a single dead shrub in plots sampled in the disturbance corridor. Spiny hopsage (*Grayia spinosa*) regenerated only locally in disturbed plots away from the road. Both species are important food sources for Mohave ground squirrel, a State of California endangered species. Scant revegetation of these chenopod species to date may result from continuing intensive cattle grazing in the area.
(4) California buckwheat (*Eriogonum fasciculatum*) and Anderson thornbush (*Lycium andersonii*) are dispersed by animals. These shrubs were found in undisturbed vegetation but were rare or absent in disturbed areas.

STUDENT PAPER

Designing a Monitoring Protocol for Desert Tortoises in Arizona

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Monitoring trends in populations of rare animals is essential for informing effective conservation and recovery programs, but can be especially challenging for animals that are widely distributed and difficult to detect reliably. Although there is no rigorous evidence to indicate that populations of desert tortoises throughout the Sonoran Desert have declined at rates similar to tortoises in the Mojave Desert, ongoing population monitoring in Arizona indicates substantial spatial and temporal variation in estimates of tortoise density and detection probability for populations south and east of the Colorado River. These sources of variation contribute to low precision of population-wide parameter estimates and have confound efforts to detect long-term trends in tortoise populations within the existing monitoring framework. Revising the current monitoring framework--including the choice of parameters to monitor, survey methods, selection of sample units, frequency of sampling, and duration of the program--would likely increase the precision of population estimates, thereby increasing the power of the monitoring program to identify long-term trends. To guide development of a revised framework for

monitoring tortoises across Arizona, we explore trade-offs in power and efficiency between monitoring occupancy or density as the primary parameter of interest and the effect of alternative sampling schemes related to the spatial extent and frequency of surveys. By using existing data to evaluate design considerations, revisions of the existing monitoring program should aid in the conservation and management of desert tortoises throughout Arizona.