ABSTRACTS

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

Prepared by Kristin H. Berry

STUDENT PAPER

A Proposed Study to Determine the Effectiveness of Transmission Line Perch Guards in Reducing Tortoise Hatchling Predation

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In the nearly treeless landscape of Southern Nevada, tall power line structures provide perching sites for any birds of prey. Ravens, in particular are drawn to areas of human activity and are known to be one of the biggest threats to the Federally listed Mojave desert tortoise. Recently Nevada Power Company built a transmission line from a new power generation station in Primm, NV to a substation in the southwest Las Vegas valley. The Bighorn transmission line runs adjacent to the Desert Tortoise Center and traverses the edge of the desert tortoise relocation area in Ivanpah valley. Dissatisfied with the effectiveness of perch guards used in the past, NPC decided to try a new model for this line to deter birds from using the structures to prey on tortoise hatchlings. This poster describes a study designed to evaluate the effectiveness of the new perch guards on the Bighorn transmission line.

Summer and Early Fall Activities of Adult Desert Tortoises at Fort Irwin, California: A Progress Report

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We have studied summer and early fall social behavior in desert tortoises at Fort Irwin since 1999. Our first project was to test hypotheses about effects of military

maneuvers on tortoise activities and behavior at the Tiefort Mountains and a nearby control site. The control site has no military use and no appreciable human disturbance. Some tortoise activities differ significantly between the Tiefort Mountains and Control sites, and differences in activities can vary by sex and sizes of the tortoises. For example, tortoises at Tiefort spend significantly more time above ground, alone, and active than tortoises at Control. Our second project is focused on determining social structure and behaviors at the control site in summer and fall. We have identified three alpha males, recorded potential defense of resources by alpha males, and documented dominance hierarchies among males. We have observed numerous aggressive interactions, copulations and attempted copulations, and apparent patrolling and guarding behaviors. Our observations and preliminary findings have management applications for translocations, modeling of epidemiology of infectious diseases, and other recovery-related subjects. *Acknowledgements*: We thank Mickey Quillman and the National Training Center at Fort Irwin for funding support.

A Comparison of Shell and Limb Colors in Desert Tortoise Populations in California: Size, Sex, and Regional Differences

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Over 1500 desert tortoises (*Gopherus agassizii*) from 20 different study sites in the Mojave and Colorado deserts of California were evaluated for shell and limb colors between 1992 and 2002 using the Munsell ® Soil Color Chart. Hue, Value, Chroma, and color name were assigned for each of six locations on the tortoises. All measurements were made when tortoise shells and integument were dry. Color data on dry soils were collected at 18 of the 20 study sites from microhabitats commonly used by tortoises: wash bottoms, wash/washlet edges or slopes, cover sites, and intershrub spaces in both undisturbed and anthropogenically disturbed sites. For analyses, tortoises were grouped by size-age into five classes by carapace length at the midline (MCL, mm): juvenile (< 100 mm), immature (100-179 mm), sub or small adult (180-208 mm), adult 1 (208-239 mm), and adult 2 ($\geq$240 mm). The 20 study sites were grouped initially into seven regions for statistical analysis of potential differences. Based on the findings, four regions were identified: Western Mojave, Northeastern Mojave, Eastern Mojave, and Colorado Desert.

We determined that adult 1 tortoises are statistically significantly different in color (e.g., central vertebral scutes) for each of four regions: West Mojave, East Mojave, Northeast Mojave, and Colorado. For juvenile tortoises, only the West Mojave and East Mojave regional data sets were statistically significantly different, possibly because of the small sample sizes for the Northeast Mojave and Colorado regions. Trends are for the small tortoises to be light in color in the centers of scutes, and, with increasing size and age, the central parts of scutes become increasingly darker. The large adults predominantly fall in the dark gray and black colors. Preliminary statistical analysis on seam and leg colors showed similar patterns of statistically significant differences by region for immature, subadult, and adult size classes.

Soil colors are generally lighter than the tortoises, even lighter than the juvenile tortoises. Many are in the Yellow-Red Hues, in contrast to the Yellow Hues for most of the tortoises. One observation that we are testing in more detail is that juveniles are more likely to approximate soil colors than the larger tortoises and as the tortoises increase in size and age, the differences between soils and tortoise colors become more pronounced. These and other findings suggest that population differences in shell and limb colors should be a consideration in recovery strategies for the tortoise. Determining the cause(s) and contributors to the differences in color by size and region will require additional research.

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The Scenting Abilities of Detector Dogs for Desert Tortoise Surveys: Pilot Study Results

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Desert tortoises and their sign can be notoriously difficult to census, especially at low population densities and in thick vegetation or rough terrain. In October, 2003 we conducted a pilot study to systematically evaluate the tortoise detection abilities of two professional detector dogs. Dog scenting ability is well documented in law-enforcement and these skills have been previously applied to other wildlife species. Work was conducted at the Lokern Natural Area in the southern San Joaquin Valley. Lokern is an Atriplex shrubland on sandy loam soils that receives about 6 inches of rain annually making it a good model of the Mojave desert. However, tortoises do not naturally occur at the site, allowing us to experimentally manipulate densities using captive animals. We deployed 13 adult tortoises, 8 subadults, and 13 yearlings over a series of 9 trials at fenced ten-acre plots. Survey teams (one dog working off-leash, one handler, and one navigator) conducted a single coverage of each plot at a 50m transect interval. Both dogs were 100% successful at locating adult and subadult tortoises, even those hidden in dense vegetation or burrows. Moreover, the dogs detected 28-50% of yearling tortoises that were buried underground in artificial burrows. These data suggest that detection dogs may greatly enhance tortoise population surveys and construction clearance activities, especially with regards to small tortoises that typically go undetected.

Road Effect Zone for Desert Tortoises: Problems and Solutions

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Roads are a pervasive landscape feature throughout the Mojave Desert. Their impacts on desert tortoise (*Gopherus agassizii*) populations are manifold and may extend well away from the road edge. The most immediate impact to tortoises is through mortality from collisions with vehicles. By one very conservative estimate, an average of 1 tortoise died annually along every 3.3 km of one highway in the western Mojave Desert. The components of the population most vulnerable to road mortality are probably adults and subadult males. Roads also cause the spread of exotic weeds, facilitate increases in local raven populations, and may introduce toxicants to the environment. Roads also aid intrusions into tortoise habitat by many human activities, some of which may be hazardous to tortoises. A zone of reduced tortoise density occurs within at least 400 m of highway edges and may extend much farther. The exact cause of this depression zone is unknown, but is likely to be the cumulative effects of the many detrimental aspects of roads. Barrier fences reduce mortality along roads, but increase population fragmentation. Passageways can help mitigate the fragmenting effects of roads and fences.

Common Raven Ecology at the Marine Corps Air Ground Combat Center (MCAGCC)

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As human communities in California deserts have grown, common ravens (*Corvus corax*), making use of anthropogenic resources, also have experienced increases. Ravens are a concern to resource managers at MCAGCC because they prey on juvenile desert tortoises (*Gopherus agassizii*) and their increase is a factor in tortoise decline. In addition, ravens have formed a large nocturnal roost on power lines, presenting a Bird Air Strike Hazard (BASH) because of the roost's proximity (3 km) to the base's air field. The broad objective of our research is to improve understanding of raven ecology to better manage the raven population. Specifically, we attempted to answer three questions: (1) are there differences in raven abundance among the anthropogenic resource sites, randomly selected features, and remote desert areas?; (2) is roosting phenology best explained by sunset, light level, or human activity?; and, (3) does raven attendance at the roost vary seasonally, with Marine training activity, or both? Results from 12 monthly surveys show that more ravens were present at attraction sites than at desert sites, suggesting that controlling raven access to subsidies may reduce their numbers on the base. Roost attendance ranged from 53 to 2100 ravens. Most ravens settled onto the roost about 30 minutes after sunset and departed from the roost about 30 minutes before sunrise. Fewer ravens attended the roost in the spring and territories at this time. Alternatively, the pattern may reflect changes in human activity on the base, as war deployments led to suspended training activities from late-winter through summer. To avoid BASH problems, Marine use of the air field should be restricted during peak periods of raven arrival and departure from the roost, especially during the fall and winter months. Results of surveys in 2004, with the resumption of normal training schedules, will determine whether roosting patterns are seasonal or are tied to Marine activities.

PLENARY ADDRESS

15 Years of Research on Disturbance Effects in Desert Tortoise Habitat

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There are many reasons why the Mojave population of the desert tortoise (*Gopherus agassizii*) is a Federally threatened species. It has been directly affected by illegal collecting, and by mortality caused by disease, predation, and crushing by vehicles and livestock. Indirect effects primarily occur via habitat loss associated with human disturbances. Although my research over the years has not focused on the desert tortoise *per se*, the results have direct implications for management of desert tortoise habitat. Below I summarize some of the major findings of projects I have been involved with over the past 15 years.

When I started my research in the late 1980s, the deserts were thought to be one of the least invaded habitats in the United States. The primary alien species recognized as potential threats to desert tortoise habitat were the grasses *Bromus rubens*, *Schismus arabicus* and *S. barbatus*, and the forb *Erodium cicutarium*. These and other alien plants can have a wide range of negative ecosystem effects within desert tortoise habitat and elsewhere (Brooks and Pyke 2001; Brooks and Esque 2002; Klinger et al. in review). We specifically know that these species can compete with and reduce the productivity of native annual plants within the Mojave Desert (Brooks 2000a), especially when alien plant growth is enhanced by increased nitrogen availability (Brooks 2003). We also now have hard evidence that both *Bromus* spp. and *Schismus* spp. can promote fire where it may not have otherwise occurred (Brooks 1999a), and that fire frequencies have gradually increased in the Mojave Desert during the 1980s and 1990s (Brooks and Esque 2002), partly due to increased dominance of alien annual grasses (Brooks and Esque 2002; Brooks and Minnich in review). The positive effects of alien grasses on fire frequency, and the subsequent positive effects of fire on alien grass dominance (Brooks 2002; Brooks and Matchett 2003), have shifted fuel structure and fire regimes outside of their natural range of variation (Brooks et al. 2003), leading to a loss of desert vegetation in some regional hotspots (Brooks and Esque 2002; Brooks and Minnich in review). This process is generally referred to as the invasive plant/fire regime cycle (*sensu* Brooks et al. in press), and is similar to the more widely recognized problem of *Bromus tectorum* converting native shrublands to alien annual grasses in the Great Basin (Brooks and Pyke 2001). Although fire is thought to be historically infrequent in the Mojave Desert, its frequency, intensity, and ecological effects likely varied among vegetation zones (Brooks and Minnich in review). Unfortunately for the desert tortoise, the lower elevation zones that comprise its habitat are among the most sensitive to damage from fire. Direct mortality from fire, and indirect effects from loss of cover sites and native forage due to fire and competition from alien plants, all pose significant threats to the desert tortoise (Brooks and Esque 2002).

Within a desert subjected to multiple uses, some are bound to conflict. For example, a recent study indicates that intense grazing near livestock watering sites can reduce the amount and diversity of perennial plant cover and native annual plant forage (Brooks et al. in review), potentially reducing the quality of desert tortoise habitat. In this study from the west-central Mojave Desert, native plant cover, species richness, and plant structural diversity were lower within increasing proximity to livestock watering sites, whereas alien plant cover was higher close to watering sites. Interestingly, the alien forb *Erodium cicutarium* and the alien grass *Schismus* spp. increased with proximity, whereas the alien annual grass *Bromus madritensis* ssp. *rubens* decreased with proximity to watering sites, suggesting that not all alien species respond the same to grazing gradients, probably because of competition among the aliens themselves. In addition, all significant effects were focused within 200 m of the watering sites, suggesting that restoration of discontinued watering sites should focus within this zone.

The prevalence of vehicle routes may also reduce the quality of desert tortoise habitat. At the Dove Springs Open Area in California, the amount of area subjected to disturbance related to off-highway vehicle (OHV) recreation increased from 7% in 1965 to over 30% in 2001 (Matchett et al. 2004). The rate of route proliferation at this site has recently tapered off, but is still increasing and is spatially correlated with washes and utility corridors. Cover and species diversity of the vegetation, and density and diversity of the soil seedbank, both declined with increasing density of OHV tracks at this site (Brooks et al. in preparation). In general, alien species were more abundant where OHV track density was high, and native species were more abundant where OHV track density was low. Biomass and species richness of alien annual plants are positively correlated with density of dirt roads (Brooks 1998; Brooks and Berry in review), and alien plants such as the new invader *Brassica tournefortii* have higher stem densities (Berry and Brooks in preparation), biomass, and seed production (Brooks and Trader in preparation) on roadsides than areas away from paved roads. Fire frequency is also associated with proximity to roads (Brooks and Esque 2002).

Fenced exclusion of human disturbances such as OHV recreation and livestock grazing can benefit desert tortoise habitat. Plant cover, biomass, species diversity, seedbank biomass, and dominance by native species were all higher inside compared to outside the Desert Tortoise Research Natural Area, approximately 20 years after it was established to protect tortoise habitat and 10 years after fencing was completed (Brooks 1992; 1995; 1999bc; 2000b). Nocturnal rodent density and diversity (Brooks 1995), plus lizard and bird abundance and diversity (Brooks 1999b), were higher inside the fenceline, whereas abundance of *Lepus californicus* was higher outside.

We now know that well over 100 other alien species occur within desert tortoise habitat (Kemp and Brooks 1998; Brooks and Berry 1999; Brooks and Esque 2002), some of which are currently expanding from the edges of the desert tortoise range (e.g. perennial grasses, Brooks and Esque 2000). Cooperative Weed Management Areas in San Bernardino and Clark counties have been established to help manage these alien plants at regional scales and across jurisdictional boundaries. A prioritization tool is now available to help rank species based on their potential ecological threats (Warner et la. 2003), and a decision-support tool has been developed to help manage species that may specifically alter fire regimes (Brooks in press). Recommendations for control of alien annual grasses are currently available (Brooks 2000cd), although their management at landscape scales is probably futile without effective biocontrol agents which have yet to be identified. In contrast, species such as *Brassica tournefortii* which is now in the process of invading are potentially amenable to mechanical or chemical control, and methods are currently being evaluated for their cost effectiveness (Brooks et al. unpublished data). Although there is still much to learn about the ecology and management of invasive plants and fire in desert tortoise habitat, we are in much better shape to do so now than we were 15 years ago.

Brooks, M.L. 2003. Effects of increased soil nitrogen on the dominance of alien annual plants in the Mojave Desert. Journal of Applied Ecology. 40:344-353.

Brooks, M.L.2002. Peak fire temperatures and effects on annual plants in the Mojave Desert. Ecological Applications 12:1088-1102.

Brooks, M.L. 2000a. Competition between alien annual grasses and native annual plants in the Mojave Desert. American Midland Naturalist 144:92-108.

Brooks, M.L. 2000b. Does protection of desert tortoise habitat generate other ecological benefits in the Mojave Desert? Pages 68-73 i*n* S.F. McCool, D.N. Cole, W.T. Borrie, and J. O'Laughlin (eds.), Wilderness Science: In a Time of Change conference, Volume 3: Wilderness as a Place for Scientific Inquiry, Missoula MT, May 23-27 1999. RMRD-P-15-VOL-3.

Brooks, M.L. 2000c. *Bromus madritensis* subsp. *rubens* (L.) Husnot. Pp. 72-76. *In* C. Bossard, M. Hoshovsky, and J. Randall (eds.). Invasive Plants of California's Wildlands. University of California Press. Berkeley, CA.

Brooks,M.L. 2000d. *Schismus arabicus* Nees, *Schismus barbatus* (L.) Thell. Pp. 287-291. *In* C. Bossard,M. Hoshovsky, and J. Randall (eds.), Invasive Plants of California's Wildlands. University of California Press. Berkeley,CA.

Brooks,M.L 1999a. Alien annual grasses and fire in the Mojave Desert. Madroño. 46:13-19.

Brooks, M.L. 1999b. Effects of protective fencing on birds, lizards, and black-tailed hares in the western Mojave Desert. Environmental Management 23:387-400.
Brooks, ML 1999c. Habitat invasibility and dominance by alien annual plants in the western Mojave Desert. Biological Invasions. 1:325-337.
Brooks, M.L. 1998. Ecology of a biological invasion: alien annual plants in the Mojave Desert. PhD Dissertation, University of California, Riverside. 186 pp.
Brooks, M.L. 1995. Benefits of protective fencing to plant and rodent communities of the western Mojave Desert, California. Environmental Management 19:65-74.
Brooks, M.L. 1992. Ecological impact of human disturbance on the Desert Tortoise Natural Area, Kern County, California, 1978-1992. M.A. Thesis. California State University, Fresno. 51 pp.
Brooks, M.L. and K.H. Berry. In review. Dominance and environmental correlates of alien annual plants in the Mojave Desert. Journal of Arid Environments.
Brooks, M.L. and K.H. Berry. 1999. Ecology and management of alien annual plants in the California deserts. CalEPPC News (California Exotic Pest Plant Council Newsletter). 7(3/4):4-6.
Brooks, M.L. and C.M. D'Antonio. 2003. The role of fire in promoting plant invasions. In M. Kelly (ed.). Proceedings of the California Exotic Pest Plant Council Symposium. Vol. 6: 29-30.
Brooks, M.L. C.M. D'Antonio, D.M. Richardson, J. Grace, J. J. Keeley, DiTomaso, R. Hobbs, M. Pellant, D. Pyke. In press. Effects of invasive alien plants on fire regimes. BioScience.
Brooks, M.L., and T.C. Esque. 2002. Alien annual plants and wildfire in desert tortoise habitat: status, ecological effects, and management. Chelonian Conservation and Biology 4:330-340.
Brooks, M.L. and T. Esque. 2000. Alien grasses in the Mojave and Sonoran deserts. Proceedings of the 1999 California Exotic Pest Plant Council Symposium 6:39-44.
Brooks, M.L., T.C. Esque, and T. Duck. 2003. Fuels and fire regimes in creosotebush, blackbrush, and interior chaparral shrublands. Report for the Southern Utah Demonstration Fuels Project, USDA, Forest Service, Rocky Mountain Research Station, Fire Science Lab, Missoula, Montana. 17pp.
Brooks, M.L, J.R. Matchett, and K.H. Berry. In review. Effects of livestock watering sites on plant communities in the Mojave Desert, USA. Journal of Arid Environments.
Brooks, M.L. and J.R. Matchett. 2003. Plant community patterns in unburned and burned blackbrush (*Coleogyne ramosissima*) shrublands in the Mojave Desert. Western North American Naturalist 63:283-298.
Brooks, M.L., J.R. Matchett, T.C. Esque, and J.F. Weigand. In preparation. Vegetation Responses to Off-highway Vehicle Disturbance at the Dove Springs OHV Open Area, California. Report prepared for the Bureau of Land Management, California State Office, Sacramento, California.
Brooks, M.L. and R.A. Minnich. In review. Desert bioregion. *In* Sugihara et al. (eds.) Fire in California Ecosystems. University of California Press.
Brooks, M.L. and D. Pyke. 2001. Invasive plants and fire in the deserts of North America. Pp. 1-14 *In* K. Galley and T. Wilson (eds.), Proceedings of the Invasive

Species Workshop: The Role of Fire In the Control and Spread of Invasive Species. Fire Conference 2000: The First National Congress on Fire, Ecology, Prevention and Management. Miscellaneous Publications No. 11, Tall Timbers Research Station, Tallahassee, Florida, USA.

Brooks, M.L. and M. Trader. In preparation. Patterns of Sahara mustard (*Brassica tournefortii*) abundance along desert roadsides.

Berry, K.H. and M.L. Brooks. In preparation. Invasion of Sahara mustard (*Brassica tournefortii*) along an eastern Mojave Desert roadside.

Kemp, P. and M.L. Brooks. 1998. Exotic species of California deserts. Fremontia 26:30-34.

Klinger, R., M.L. Brooks, and J. Randall. In review. Fire and invasive plants. *In* Sugihara et al. (eds.) Fire in California Ecosystems. University of California Press.

Matchett, J.R., L. Gass, M.L. Brooks, A.M. Mathie, R.D. Vitales, M.W. Campagna, D.M. Miller, and Weigand, J.F. 2004. Spatial and Temporal Patterns of Off-highway Vehicle Use at the Dove Springs OHV Open Area, California. Report prepared for the Bureau of Land Management, California State Office, Sacramento, California. 17pp.

Warner, Peter J., Carla C. Bossard, Matthew L. Brooks, Joseph M. DiTomaso, John A. Hall, Ann Howald, Douglas W. Johnson, John M. Randall, Cynthia L. Roye, Maria M. Ryan, and Alison E. Stanton. 2003. Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. Available online at www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

Chelonian Serodiagnostics: Development of a Field Portable Assay For Detection of Exposure of Tortoises to *Mycoplasma agassizii*

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Infectious disease has affected plans for management and conservation of protected chelonians in the United States. Tortoise conservation and recovery plans now include testing for mycoplasmal Upper Respiratory Disease (URTD). Detection of specific anti-mycoplasma antibodies may be used to diagnose infection and immune status of chelonians as a tool for disease management. We have evaluated the feasibility of a field test for specific antibodies against mycoplasma in chelonian plasma, which would provide nearly instant information for management decision making. Preliminary trials were conducted of evanescent-wave biosensor technology for detection of specific anti-*Mycoplasma agassizii* antibodies in plasma from *Gopherus agassizii* tortoises. The evanescent-wave biosensor is a laser-based polystyrene fiber optic sensor which detects specific *G. agassizii* anti-*M. agassizii* antibody bound to *M. agassizii* whole-cell lysate antigen. The reporter molecule was Cy5-labeled HL637 monoclonal antibody against tortoise immunoglobulin. Under various experimental protocols, the signals from positive control plasma samples from our bank were three to seven times higher than the signals from negative control plasma samples. A randomized double-blind study was then conducted to determine the sensitivity, specificity, positive predictive value, and negative predictive value of the technique. Preliminary analyses of the results indicate a greater than 90% concordance with the traditional ELISA sample categorization, with a 5 minute per sample, field-portable protocol. Those results suggest that this technology is feasible for application under field conditions. Understanding the dynamics of disease spread in natural wildlife populations may also provide valuable new insights into host:pathogen:population interactions in this era of emerging infectious diseases.

Anthropogenic Impacts on Mycoplasmosis in a Florida Gopher Tortoise Population and Increased Morbidity and Mortality Events

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Anthropogenic impacts, particularly release of captive animals, has been hypothesized to play a role in the transmission dynamics of upper respiratory tract disease (URTD) in wild tortoise populations. Similarly, the role of relocation events on disease transmission has been questioned. While it is unlikely that a single explanation will account for all observed disease outbreaks, systematic investigations of selected populations may permit development and validation of general principles that are important in determining the disease transmission dynamics as well as both short and long term impacts on the populations.

The gopher tortoise population at the Cecil Field site in northeast Florida has been intensively studied since 1996, with mycoplasma surveys and health assessments performed in 1996, 1998-2001, and 2003. The study site is a state owned and managed gopher tortoise preserve that was established using funds from development mitigation fees. Signage is present informing visitors that the preserve was established specifically to protect and preserve gopher tortoises and their habitat. Originally, the property surrounding the preserve was part of a military base and thus access was limited. In 2000, the base was decommissioned and development of the surrounding areas began. Roads and other infrastructure were added, small mini-ranchette subdivisions were built directly adjacent to the preserve, and large scaled planned communities are presently under development within two to three miles of the preserve. Circa 2001/2002, well-intentioned individuals living in the area released gopher tortoises found on roadways throughout the Jacksonville, FL into the preserve. These relocations were not permitted and were unauthorized.

Prior to 2001, the percentage of animals that tested positive by ELISA for antibodies to *M. agassizii* was $\leq 20\%$. Isolation of mycoplasmas from nasal lavages was a rare event prior to 2003; only 5 animals of 69 animals tested during this 5 year time period ever had positive PCR results. *Mycoplasma testudineum* (formerly known as *M. cheloniae*) was the only mycoplasma species identified from this site. In 2003, a dramatic change was observed. Seropositive animals increased to 75% and 58% (14/24) had nasal lavages that were positive by PCR. Importantly, the mycoplasma species present was *M. agassizii*. Six animals sampled in 2003 had also been sampled in previous years; all were seropositive in 2003 whereas only one tortoise had a prior positive ELISA. Five of these 6 tortoises were PCR positive in 2003.

A dramatic increase in morbidity and mortality accompanied the change in the serologic profile and shift in mycoplasmal species present in the CF population. Prior to 2003, mild nasal discharge was observed in only 2 of the 69 (3%) tortoises sampled and minimal ocular signs were observed. In 2003, 11 of 23 (48%) tortoises had nasal discharge, ranging from clear to cloudy. Ocular signs were also increased in frequency and severity. With the exception of 2000 when 4 deaths were documented, mortality events were relatively rare (≤1 shell/year) in this population. In 2003, 7 recent mortality events were documented.

The results from this survey suggest that introduction of *Mycoplasma agassizii* into this naïve population resulted in an acute disease outbreak. Although not conclusive, the data suggests that in this population unauthorized relocation of tortoises and increased anthropogenic impact may have been triggering events. The population will be monitored intensively over the next four years to document the natural progression of the disease outbreak and its impact on population dynamics, morbidity and mortality.

Desert Tortoise Conservation and Recovery Accomplishments of the Desert Tortoise Preserve Committee in 2003

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The Desert Tortoise Preserve Committee (DTPC) has worked since 1974 to promote the welfare of the desert tortoise in its native wild state by developing and managing preserves, and through research and education. The Committee made significant advances in each of these areas in 2003.

The DTPC was instrumental in establishing the 39.5 square mile Desert Tortoise Research Natural Area (DTNA) at a location in the western Mojave Desert known to have a very high carrying capacity for desert tortoises. Since then, DTPC has worked to consolidate the DTNA by purchasing private inholdings to manage them for tortoise recovery. Although the DTNA is too small to be viable as a stand-alone recovery area, it has become increasingly threatened with isolation from critical habitat by human activities on the surrounding lands. In 2002, DTPC embarked on a major initiative to facilitate desert tortoise recovery and conservation by expanding the Natural Area to create more defensible boundaries and to provide a viable corridor to designated critical habitat to the east. In 2003, DTPC acquired an additional 519 acres in and around the DTNA and began working to secure support for the expansion proposal from the wildlife agencies. The Committee's acquisitions in the eastern expansion area are now nearing the critical mass of contiguous parcels needed to facilitate the fencing required exclude unauthorized vehicles and sheep.

Major new tortoise management actions included the design and construction of a tortoise crossing under Harper Lake Road. This culvert will reduce population fragmentation by allowing tortoises to move across fenced stretches of the road. Although drainage culverts under major highways such as Highway 58 are available for use by tortoises, the Harper Lake Road culvert is the first purpose built tortoise crossing in the West Mojave region. Because it is not a drainage culvert, it can be closed temporarily and so provides a potential mechanism to restrict tortoise movement, should such management be required.

The DTPC continued its research and monitoring programs with significant surveys for desert tortoise and two other species that share the tortoise's habitat. Detailed studies of desert tortoise population, demography and health status were initiated at a site within the existing Natural Area identified as potentially suitable for the development and implementation of experimental recovery techniques such as head starting. Successful Mohave ground squirrel trapping surveys were conducted on DTPC lands in the DTNA eastern expansion area. DTPC continued its work at the Chuckwalla Bench by conducting the first systematic surveys for the rare Harwood's milkvetch. Four new locations for the plant were identified in the Chuckwalla Desert Wildlife Management Area.

For the fifteenth consecutive year, a DTPC Naturalist provided interpretive services and monitored visitors at the DTNA. In partnership with the Kern County Library, DTPC placed one of its Mojave Desert Discovery Center kiosks at the California City Branch Library. The California City Branch Library is located 5 miles south of the DTNA Interpretive Center and is an ideal location for outreach to the local community.

Evaluating Trauma in Live Desert Tortoises: Wild vs. Domestic Canids A Preliminary Report

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Desert tortoise (*Gopherus agassizii*) populations have declined for numerous reasons in recent decades. Trauma (defined as injury to the shell or soft tissues caused by impact or predation) from vehicles, predators, and domestic livestock have contributed to poor health and increased mortality rates in some areas. We developed a method of grading trauma to live desert tortoises using 35-mm slides and data sheets. We are retrospectively evaluating data sets from long-term permanent plots, health and disease studies, and miscellaneous research projects. The database will include site; date; tortoise identification, sex, and size; percentage of injury to each scute and limb; type of injury; potential source of injury; distance from towns and settlements; and many other attributes. Our objectives are to characterize the types of trauma affecting live tortoises by size, sex, and location, and ultimately to address critical recovery issues. One important recovery issue, identified in the *Desert Tortoise Recovery Plan* (U.S. Fish and Wildlife Service, 1994), is attack by domestic or feral dogs. Tortoise populations most likely to be affected are near towns and cities. With our developing database, we have taken a preliminary look at differences in trauma from wild vs. domestic canids. We present examples from a few sites in the Western Mojave Recovery unit, comparing sites near settlements (Sand Hill, Daggett, Lucerne Valley) with a remote site at Fort Irwin. In general, attacks by dogs differ from attacks by wild canids in the amount and type of scute removed and bone exposed, especially to the gular horn. In the few samples we have evaluated to date, tortoises at sites within 3 km of settlements or isolated houses show more severe damage to shells and limbs than tortoises at remote sites.

The Role of USGS in the Recovery of the Desert Tortoise

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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 merger of the biological resources discipline into the USGS provided opportunities for scientific collaborations among four major disciplines including biology, geology, hydrology and geography. USGS contributes to the recovery of tortoises by conducting agency consultations, literature reviews and syntheses, hosting workshops, and conducting research aimed at describing ecological pattern, process and mechanism. Establishment and maintenance of permanent study plots provides data for the analysis of population trends and general ecology. Application of information stemming from research on raven ecology is used to increase juvenile tortoise survival and recruitment. USGS provides syntheses on the influence of roads on tortoises provides guidance on how to reduce road impacts. Research on desert tortoise health, upper respiratory tract disease, shell disease and environmental toxicants, as well as, analysis of shell remains has been a major topic of research and information dissemination. Several studies focused on the effects of fire and invasive species on desert tortoises and their habitat, arid land restoration, assessment techniques, livestock grazing, off-highway vehicle recreation, and invasive plants on desert tortoise habitat. Ecological studies include desert tortoise reproduction, diet and nutrition, and carrying capacity. Joint meetings between scientists from diverse disciplines and many institutions improved communications thus focusing research efforts to the benefit of desert tortoises and their recovery.

Defense Department Participation in Desert Tortoise Management

Colonel Edward L. Flinn, Deputy Commander and Chief of Staff

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Much desert tortoise research has either taken place on Department of Defense (DOD) lands or been funded by military installations. DOD installations are and will continue to be active participants in collaborative groups such as the Desert Managers Group, the West Mojave Coordinated Management Plan, the Desert Tortoise Management Oversight Group, and other organizations focused on ecosystem management of the desert tortoise. A formal committee of military land managers meets regularly to discuss and coordinate DOD installation resource management actions.

The DOD is committed to long-term tortoise management and ultimately, delisting of the species. As an agency, we urge other federal land management agencies to follow our lead. Without a cooperative and collaborative effort throughout the range of the tortoise, no single agency can achieve the goals outlined by the Desert Tortoise Recovery Plan.

The Sikes Act requires all installations complete and implement an Integrated Natural Resources Management Plan (INRMP). These plans detail research and military installation land management goals for a period of five years. They are completed with the cooperation of the USFWS and the appropriate state wildlife management agency to insure these plans meet the goals of the recovery plan. This presentation will focus primarily on these and other "desert-wide" issues, such as sustainable training, encroachment and the loss of habitat due to urban development and is intended to provide an overview of tortoise conservation efforts currently ongoing on military installations throughout the Mojave Desert.

Gopher Tortoise Evolution: East vs West. A Possible Paradigm Shift

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The fossil record of *Gopherus* begins with *G. laticuneus* more than 32 million years ago in the White River sediments of the Late Eocene of Colorado, Nebraska, South Dakota, and Wyoming. Large samples of *G. laticuneus* from a ranch near Toadstool Park in northwestern Nebraska show that it already had obtained many of the features that link it to more modern gopher tortoise taxa. This gopher tortoise achieved a large body size, and it occurred commonly with another large tortoise in the genus *Stylemys*. From this meager beginning, gopher tortoises radiated into a plethora of species in the Miocene and Pliocene in the West. Sometime during this period the two clades, one leading to *G. polyphemus* and *G. flavomarginatus*, and the other to *G. agassizii* and *G. berlandieri*, diverged into separate lineages. Molecular data suggest this split occurred 17-18 million years ago. Unfortunately, the fossil record provides little assistance in sorting the important events of this shift. When and where did this split occur?

Numerous characters have been used to differentiate members of each clade. The most defining characters, unfortunately, concern the head, neck, and front legs, which are rarely preserved as fossils. Bramble (1982) suggested that the peculiar anatomical features found in the members of the *polyphemus-flavomarginatus* (board-headed) clade are related to the mechanics of digging. These features were either not present or only weakly developed in members of the *agassizii-berlandieri* (narrow-headed) clade. Bramble (1982, *Copeia* (4):853-867) placed the latter clade in the genus *Scaptochelys* (also *Xerobates* of other authors) based on the absence of these features. Fortunately, one of the defining characters for the *polyphemus-flavomarginatus* clade is portrayed by a ventral strut that extends from the base of the first dorsal vertebra and attaches to the internal surface of the nuchal plate. Bramble considered the ventral strut as a method of strengthening the neck and body connection during burrowing activities. This strut is marked by a prominent bone scar on the posterior edge of the nuchal plate on closely related fossils, which in our opinion signals them as a specialized burrowing species in the *polyphemus-flavomarginatus* clade.

Traditional wisdom suggests that gopher tortoises (*Gopherus*) are recent invaders into the Gulf and Atlantic coastal plains from the West and the East has played little or no significant role in gopher tortoise radiation. However, a succession of more than 60 fossil sites with *Gopherus polyphemus* from the Late Pliocene (Blancan) and Early, Middle (Irvingtonian), and Late Pleistocene (Rancholabrean) in Florida, Georgia, Mississippi, and South Carolina and recent discoveries of *Gopherus*-like fossils from the Middle Oligocene (Whitneyan and Arikareean) and Late Miocene (Hemphillian) in South Carolina and Florida tell a different story. The populations of Plio-Pleistocene gopher tortoises from the Southeast best fit with *G. polyphemus*, although the earliest samples suggest much smaller forms existing in Florida two million years ago, then shifting to larger forms, often exceeding *G. flavomarginatus*, in the Late Pleistocene. All of these fossil samples from Florida show prominent scars on their nuchal bones, which not only document their taxonomic identity, but also signal their abilities to burrow. Based on this feature and the ecological requirements of modern *polyphemus*, we conclude that fossil gopher tortoises dug extensive burrows and lived in fire-prone droughty sites, similar to the sandhill, scrubby flatwoods, and scrub habitats that occur in the Southeast today. The presence of gopher frog (*Rana capito*) and Florida mice (*Podomys* sp.) fossils with gopher tortoise fossils in Late Pliocene and Pleistocene sites indicate that the unique obligate burrow commensal fauna was already in place in Florida two million years ago.

Several amazing mid-Tertiary fossils from the Southeast suggest that gopher tortoises may have been part of the southeastern coastal plain fauna for 28 million years. The most ancient *Gopherus*-like tortoise is from the Chandler Bridge Formation, near Charleston, South Carolina. This species, represented by a complete anterior half of the carapace, has many traits of the *polyphemus-flavomarginatus* clade, including the presence of the ventral strut scar on the nuchal. This fossil species apparently lived in a coastal site, possibly a barrier beach situation, similar to that occupied by gopher tortoise colonies today along Atlantic coast. Two other fossil tortoise taxa, both from Florida, also have gopher tortoise traits, but because of their fragmentary nature, we cannot ascertain with certainty their true identity until more material becomes available. Both fossil samples consist of epiplastral bones and several carapace and plastral fragments. We will attempt to place these ancient fossils in the context of the tortoise fossil record.

In summary, the fossil record, although spurious, suggests that the Southeast may have played a more vital role in the evolution of gopher tortoises than previously believed. We have known that a smaller relative of the modern *Gopherus polyphemus* suddenly appears in the Southeast two million years ago, bringing with it, not only its ability to burrow, but also its burrow commensal fauna. Did the smaller Late Pliocene form become the larger Late Pleistocene tortoise, the precursor of the modern populations? Did the large gopher tortoises of the Pleistocene disperse westward, then fragment becoming *Gopherus flavomarginatus*? Or vice-versa? Do the mid-Tertiary tortoises fit with the more widely accepted paradigms? The South Carolina fossil is second in age only to the oldest known species, *Gopherus laticuneus*. It, however, has the strut, and *G. laticuneus* does not. Does this indicate that burrowing may have evolved first in the East and spread westward? Much more work is necessary on the fossil tortoise record in North American before we truly understand the evolution of the group.

Roads, Invasions, and the Desert Tortoise: How Combinations of Environmental Conditions Explain Patterns of Exotic Plant Invasion

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Roads are believed to be a major contributing factor to the ongoing spread of exotic plants, which in turn influences the quality of desert tortoise habitat. We examined the effect of road improvement and environmental variables on exotic and native plant diversity in roadside verges and adjacent semiarid grassland, shrubland, and woodland communities of southern Utah (U.S.A.). We measured the cover of exotic and native species in roadside verges and both the richness and cover of exotic and native species in adjacent interior communities (50 m beyond the edge of the roadcut) along 42 roads stratified by the level of road improvement (paved, improved surface, graded, and four-wheel-drive track). In roadside verges along paved roads, the cover of *Bromus tectorum* was three times as great (27%) as in verges along four-wheel-drive tracks (9%). The cover of five common exotic forb species tended to be lower in verges along four-wheel-drive tracks than in verges along more improved roads. Richness and cover of exotic species were both more than 50% greater, and richness of native species was 30% lower, at interior sites adjacent to paved roads than adjacent to four-wheel-drive tracks. In addition, environmental variables relating to dominant vegetation, disturbance, and topography were significantly correlated with exotic and native species richness and cover. Improved roads can act as conduits for invasion of adjacent ecosystems by converting natural habitats to those highly vulnerable to invasion. However, variation in dominant vegetation, soil moisture, nutrient levels, soil depth, disturbance, and

topography may render interior communities differentially susceptible to invasions originating from roadside verges. Plant communities that are both physically invasible (e.g., characterized by deep or fertile soils) and disturbed appear most vulnerable. We suggest that researchers use combinations of environmental conditions to understand complex invasion patterns not explainable by using single factors such as the presence of roads or disturbance. This conceptual framework holds substantial promise as scientists and land managers seek to understand how and where to improve management of roadside and adjacent interior communities to prevent and minimize invasions, and, in turn, to protect sensitive species such as the desert tortoise.

Interactions Between Gila Monsters and Desert Tortoise

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Gila monsters and desert tortoises share many of the same ecological characteristics including similar geographic distributions, low reproductive rate, and long life-span. We describe interactions among these species at a single study site in southern Nevada. Gila monsters and tortoises used many of the same refuge sites, both concurrently and at separate times. Gila monsters shared refuge sites with female tortoises disproportionately than would be expected by chance, and analysis of diet samples for Gila monsters suggest that desert tortoise eggs are an important food resource. We also describe agonistic encounters between the species, and report on nest defense behavior by a female tortoise against a Gila monster.

STUDENT PAPER

Quantitative Review of the Adequacy of Knowledge of Different Age Stages of the Desert Tortoise, *Gopherus agassizii*

Brigette Hagerty, Franziska Sandmeier, C. Richard Tracy

The latest published annotated bibliography on desert tortoises (*Gopherus agassizii*) identified trends in tortoise research prior to 1991 (Grover and Defalco 1995), and mentioned gaps in knowledge, which influenced research prescriptions in the Desert Tortoise Recovery Plan (1994). The recovery plan highlighted the need for long-term research on desert tortoise demography, threats to persistence, and the effectiveness of mitigation measures (USFWS 1994). The recovery plan prescribed research on non-reproductive age classes. The purpose of our study is two fold: 1) identify gaps in knowledge of immature desert tortoise age classes and 2) compare the foci of research before and after the publication of the recovery plan. We have quantified differences in the knowledge base for different age classes of *G. agassizii*, and we show gaps in knowledge of the biology of adolescent tortoises where new data are needed to fill the information gaps on the biology of desert tortoises and on the management of tortoise populations.

Grover, M.C. and L.A. DeFalco. 1995. Desert tortoise (*Gopherus agassizii*): Status-of-knowledge outline with references. U.S. Department of Agriculture, Forest Service, Intermountain Research Station:134 pgs.

Desert Tortoise Management and Recovery Actions Within the National Park System

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Lake Mead National Recreation Area

The National Park Service (NPS) manages four large areas in the Mojave Desert. They include the largest National Park in the continental U.S., Death Valley, with 3,336,000 acres, Joshua Tree National Park with 1,017,748 acres, the Mojave National Preserve with 1,589,165 acres and Lake Mead National Recreation Area with 1,495,664 acres. The primary management objective for NPS lands as stated in the Organic Act of 1916 is to conserve resources in a manner that leaves them unimpaired for future generations. Consequently, management of park lands to benefit tortoise recovery is completely compatible with the broader goal for which these lands have been set aside. The NPS has engaged in a number of conservation activities on these lands since the tortoise was listed, and was actually engaged in management which was largely compatible with the tortoise recovery plan before the tortoise was even listed. Still, each unit of the NPS, although managed under one set of general policies, can also be managed somewhat differently as provided for in the enabling legislation passed by Congress when it creates each new unit. As a result, some park lands have been, and are still, subject to a variety of uses that are not generally compatible with tortoise recovery. Changes have been occurring to remedy these situations, progress has been made, but more work remains to be done.

Recovery Action Program for the Desert Tortoise in California

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Several agencies in the Department of the Interior agencies (Fish and Wildlife Service, Bureau of Land Management, National Park Service and Geological Survey) and the State of California (Department of Fish and Game, Department of Parks and Recreation) are considering entering into a Memorandum of Agreement to participate in the Recovery Action Program for the Desert Tortoise in California (Program). The purpose of the Program is to:

(1) Establish a framework for coordinating and integrating recovery actions among managers and scientists across jurisdictional boundaries in California,
(2) Put into place the basic support elements necessary to recover the desert tortoise in California, and

(3) Coordinate implementation of specific recovery actions that require interagency cooperation for effective implementation throughout the California deserts.

Basic support elements included in the Program are an interagency annual work planning process, science and data management support, desert tortoise monitoring, and public outreach and education. Several high priority recovery actions will be implemented including raven management, feral dog management, head starting and translocation and disease management. Mechanisms are provided to ensure that the Program is carried out in consultation and cooperation with affected stakeholders, local communities, and the public.

The Desert Managers Group will coordinate implementation the recovery actions identified in the Program. The MOA will establish a Regional Executive Management Group to oversee and guide implementation of the Program. DOI agencies are inviting public comment on the Program until March 5, 2004. Copies of the Program are available from the author or at *www.dmg.gov/documents*.

Desert Tortoise Decision Support: Modeling Knowledge

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The decline of the desert tortoise (*Gopherus agassizii*) is a challenge for scientists and land managers in the Western Mojave. Both groups must analyze and understand large volumes of data and knowledge that are often riddled with gaps and uncertainty. The Redlands Institute Desert Tortoise Project is using Ecosystem Management Decision Support (EMDS™) to assist scientists and managers in understanding the interrelationships, uncertainty, and relative influence of scientific knowledge on modeling desert tortoise habitat. EMDS consists of three components: a knowledge base, a landscape assessment, and a decision analysis system. EMDS is a tool for understanding desert tortoise knowledge, modeling desert tortoise habitat, and prioritizing research and data collection efforts based on the influence of missing data and knowledge within the model. This paper will focus on the process and results of the habitat potential knowledge bases, with a brief explanation of the landscape assessment and decision analysis system. The knowledge base is a hierarchal model acting as a conceptual map of desert tortoise knowledge and data. The knowledge base is constructed through a collaborative process involving a combination of literature review and knowledge modeling workshops with desert tortoise experts. This paper will provide a brief introduction on EMDS tools and concepts, results of the collaborative model building process, and an overview of the habitat potential knowledge base.

Desert Tortoise Management Issues: Cooperation and Potential for Partnerships

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The QuadState County Government Coalition represents local governments, through their elected officials, in six counties within the four-state region that embraces desert tortoise habitat and populations. The organization is involved with desert tortoise management issues on behalf of their jurisdictions and their constituents. It has also become involved in a variety of related land use and policy issues including the Lower Colorado River MSCP, advocacy for changes in regard to the Federal Payment in Lieu of Taxes (PILT) Program to reflect Federal land acquisition effects on property tax base, and R.S. 2477 assertions.

Local governments provide a source of public accountability through its elected officials.

The Coalition continues to participate with the Management Oversight Group (MOG) and has also worked with the Assessment Committee (DTRPAC) as they look at the 1994 Recovery Plan, including hiring a biometrician who has provided input to the Committee. We continue to believe, as we stated last year, that the current Recovery Plan has significant flaws.

The Coalition is not anti-tortoise. We favor sound and reasonable land management. We ask for reasonableness in developing and implementing land use plans. This includes assessing the effects on users as well as looking at overall costs of implementation.

There are a number of areas of common ground. We need to find more and improve our dialogue.

- We need to focus on recovery where there is the greatest chance of real and permanent recovery.
- We need to find scientifically valid means of directing mitigation for habitat management and protection and perform investments where they have the best chance of return.
- We must solve the disease and predation issues.
- We need to come to an understanding regarding tax base erosion. If land acquisition is to continue as a primary source of mitigation, then we need your support in getting H.R. 380 passed during the current session of Congress.
- We need to commit to monitoring, and better evaluate the effects of our mitigation efforts.

We ask that you not lose sight of the fact that land use decisions affect real people and real livelihoods, and the decisions implemented require significant investment of both private and public funds. There needs to be assurance, and proof, that such investment will have a measurable and meaningful payoff.

Desert Tortoise Decision Support: Landscape Analysis

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This paper builds upon the foundation introduced and explored in the paper titled: Desert Tortoise Decision Support: Modeling Knowledge. Ecosystem Management Decision Support (EMDS^{TM}) provides a platform for understanding desert tortoise knowledge, modeling desert tortoise habitat, and prioritizing research and data collection efforts based on the result of the model, as well as the influence of missing data and knowledge within the model. This paper will focus on the results of a landscape based desert tortoise habitat analysis, drawing upon the hierarchal model of desert tortoise knowledge presented earlier, and spatial data to illustrate the importance of identifying both gaps in current scientific knowledge and in current data. Current data may not adequately reflect current scientific understanding, yet is still used to develop spatially explicit models. Conversely, many spatial models draw upon comprehensive data, yet only incorporate partial knowledge. Unlike traditional habitat models, our model allows for the transparent exploration of differential spatial results, and thus creates the ability to identify the spatial consequences of incomplete or inexact knowledge. Model inputs are prioritized by their relative contribution to the model output, and can be mapped for uncertainty. For example, the spatial implications of incomplete or inexact knowledge of desert tortoise retreat sites can be mapped and thus more easily understood by scientists or articulated to managers. The results presented in this paper illustrate the significance of transparent models, collaborative model development, and improved spatial data compilation standards.

Mitigating Highway Impacts on Wildlife

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Animal passage systems can be designed to facilitate movement of certain wildlife species across highways. Where the conservation of a particular species or group of species is concerned, specifically designed mitigation has proven successful for a number of species. However, the effectiveness of highway mitigation systems has not been evaluated with respect to the vast majority of wildlife. It is probable that some species do not require specific design features while others will require careful attention

to factors such as placement, size, substrate, noise, temperature, light and moisture. In areas where road and highway density is high, conservation of particular species may be of lesser concern than the maintenance of overall habitat connectivity. While it is impractical to design mitigation projects that account for the specific requirements of all species affected by a highway, it may be possible to develop a generalized strategy for making highways more permeable to wildlife passage for a larger number of species. This strategy will require use of a variety of techniques given that the specific requirements for particular species may be contradictory. Some of the most effective techniques for facilitating wildlife movement (i.e. overpasses) are also quite expensive. A practical strategy for mitigating highway impacts on wildlife movement may dictate that expensive elements be reserved for areas that are identified as important travel corridors or connections between areas of significant habitat, while inexpensive elements (amphibian and reptile tunnels) can be used at appropriate areas throughout the highway alignment.

Necropsies of Six Desert Tortoises (*Gopherus agassizii*) from California

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Five male and one female desert tortoises (DT), *Gopherus agassizii*, were received at the University of Florida during 2002-2003 from Edwards Air Force Base, CA (n=1), Riverside County, CA (n=1), and San Bernardino County, CA (n=4), for complete evaluations. Five were salvaged alive and one was found dead in the field. Evaluations included hematology, plasma biochemicals, and urinalysis on live tortoises and full necropsies on all tortoises. Of the 6 DT, five had clinical signs and microscopic lesions of upper respiratory tract disease (URTD). Of the four live tortoises with URTD, all were ELISA positive for exposure to *Mycoplasma*. And using PCR, *Mycoplasma agassizii* was confirmed in the nasal cavity of four tortoises. Of the five live tortoises, one tortoise was ELISA positive for exposure to tortoise herpesvirus using two herpesvirus as antigens in the assay and three were ELISA positive with only one of the two antigens used in the assay. Using PCR, herpesvirus sequences were found in the brain of three tortoises. One tortoise that had URTD also had certain changes in the liver indicative of a possible toxic exposure. The tortoise submitted dead had lesions in the kidney supportive of renal failure. Another tortoise had crystals in the kidney and thyroid that were similar in appearance to oxalate; plasma biochemical findings for this tortoise were supportive of a diagnosis of renal failure. Two tortoises had an unusual proliferative pneumonia with hyperplasia of smooth muscle fibers in the interstitium of the lung. The principle investigator has not previously seen these unique changes.

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

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The listing of the desert tortoise as a threatened species under the Endangered Species Act has significantly influenced the manner in which the BLM administers public lands in southern Nevada. The BLM administers approximately 4.5 million acres of desert tortoise habitat in Clark, Lincoln, and Nye counties, Nevada, of which 1,085,000 acres have been designated as critical habitat. There is almost no activity that BLM authorizes within our Las Vegas, Tonopah, and Caliente Field Offices (FO) that does not affect desert tortoise. BLM in NV has eliminated or reduced livestock grazing on significant portions of desert tortoise habitat in these areas. Active management to maintain desert tortoise populations is ongoing: BLM personnel are actively involved in preventing desert tortoise collection, and vandalism; management changes have been made to reduce mortality from various motorized vehicle activities; utility and energy facilities and corridors are evaluated and impacts mitigated; and wildfires in desert tortoise habitat receive priority response and emergency stabilization as quickly as possible. BLM is actively participating in the development and implementation of several Multiple Species Habitat Management Plans. Land sales in Clark and Lincoln Counties are funding habitat acquisition, parks, installation of protective fencing and other activities in support of desert tortoise conservation.

STUDENT POSTER

Road Mortality of Snakes on the Eastern Snakes River Plain

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This research documents the magnitude of road mortality of snakes, provides insight into how this mortality differentially impacts individuals, and examines the seasonal patterns by sex and age class. I conducted the study by road cruising a 160-km road loop in the eastern Snake River Plain of Idaho from May through October of 2003. I observed a total of 259 snakes on roads along the survey route and across the entire survey period; ninety percent of these animals were found dead on the road surface. I recorded the road mortality of 4 species of snakes belonging to families Colubridae and Viperidae. However, the majority of observations belonged to 2 species with Gopher Snakes (*Pituophis catenifer)* comprising 74% of all road records, and Western Rattlesnakes (*Crotalus viridis)* comprising 18% of all road records. Overall, I observed adult males more often than any other age or sex class. Road mortality varied seasonally across age and sex classes, and between species. The average number of snakes observed per day while road-cruising was highest during the month of September, although this result is not statistically significant due to the high variance in the numbers observed per day across months. Spatial analysis of the data indicates that the observations are clustered across the survey route. Future analyses will focus on identifying which landscape factors affect the spatial pattern of road mortality. Such analyses may help with efficient placement of mitigation efforts.

Iridovirus Infections of Turtles and Tortoises

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Iridoviruses are DNA viruses capable of infecting invertebrates and poikilothermic vertebrates. Five genera are recognized, of which the genus *Ranavirus* has been shown to infect fish, amphibians and reptiles (Mao et al, 1997). Several accounts of iridovirus infection have been documented in chelonians (Heldstab and Bestetti, 1982, Marschang et al, 1999). In the U.S., only three cases have been reported; a Russian tortoise (*Testudo horsfieldii*), and a box turtle (*Terrapene carolina*) in which no pathology was mentioned (Mao et al, 1997) and a wild gopher tortoise (*Gopher polyphemus*) that had signs of respiratory disease (Westhouse et al, 1996). Between July and October 2003, a captive Burmese star tortoise (*Geochelone platynota*) from Georgia, a wild gopher tortoise (*Gopherus polyphemus*) from Florida and six Eastern box turtles (*Terrapene carolina carolina*) from Pennsylvania were found to be infected with iridovirus. Clinical signs were similar to those seen with herpesvirus infection and included conjunctivitis, rhinitis, and stomatitis. On histopathology, necrosis of multiple tissues was seen and basophilic intracytoplasmic inclusion bodies were observed in epithelial cells of the oral mucosa and hematopoietic cells in several organs. From the tortoises and box turtles, a virus compatible with iridovirus was isolated in *Terrapene* heart cells and using PCR, a segment of the gene encoding the major capsid protein was amplified and sequenced. BLAST analysis indicated that the DNA segment was most closely related to that of Frog Virus 3. An iridovirus with the same DNA sequence as the isolate from the Burmese star tortoise was isolated from an ill leopard frog in the star tortoise's enclosure suggesting amphibians may serve as a reservoir host for chelonians.

References:

Heldstab, A., and G. Bestetti. 1982. Spontaneous viral hepatitis in a spur-tailed Mediterranean land tortoise (*Testudo hermanni*). Journal Zoo Animal Medicine 13:113-120.

Mao, J., R.P. Hedrick, and V.G. Chinchar. 1997. Molecular characterization, sequence analysis and taxonomic position of newly isolated fish iridoviruses. Virology. 229: 212-220.

Mao,J., D.E. Green, G. Fellers, and V.G. Chinchar. 1999. Molecular characterization of iridoviruses isolated from sympatric amphibians and fish. Virus Research. 63:45-52.

Marschang, R.E., P. Becher, H. Posthaus, P. Wild, H-J. Thiel, U. Müller-Doblies, E.F. Kaleta, and L.N. Bacciarini. 1999. Isolation and characterization of an iridovirus from Hermann's tortoises (*Testudo hermanni*). Archives of Virology. 144:1909-1922.

Westhouse, R.A., E.R. Jacobson, R.K. Harris, K.R. Winter, and B.L. Homer. 1996. Respiratory and pharyngo-esophageal iridovirus infection in a gopher tortoise (*Gopherus polyphemus*). Journal of Wildlife Diseases. 32: 682-686.

POSTER

Preliminary Distribution of Upper Respiratory Tract Disease in Captive and Free-ranging Desert Tortoises in Greater Tucson, Arizona

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Upper Respiratory Tract Disease (URTD), caused by the pathogen *Mycoplasma agassizii*, poses a critical threat to the Mojave population of the desert tortoise (*Gopherus agassizii*), where release of captive tortoises into the wild has been implicated in the spread of the disease. Little is known about URTD in the Sonoran population of the desert tortoise. To determine the distribution of URTD in Greater Tucson, Arizona we used enzyme-linked immunosorbent assay (ELISA) to detect antibodies indicating previous exposure to *M. agassizii*. Blood samples were collected in 2002 and 2003 from 52 captive tortoises within Tucson and 117 free-ranging tortoises in 9 mountain ranges along an urban gradient radiating from Tucson. We compared results from captive and free ranging populations to determine if there is an association between urbanization and distribution of *M. agassizii*. Results of this study will shed light on geographic patterns of URTD and may help elucidate the relationship between a very large captive population and free-ranging population. This study has implications for other diseases that may be spread into urban wildlife habitat as human development continues to encroach upon mountain foothills.

Drought: Acute Effects and Impacts to Recovery of the Desert Tortoise

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The Mojave desert has experienced an unusually severe drought cycle in the past 15 years. In the west Mojave, 7 of the past 15 years have been spring droughts with negligible or well below-average forage production. In the east Mojave, spring droughts have occurred in 8 of the past 15 years. Desert tortoise populations have declined dramatically during this period. Declines that have been documented for specific year groups are overwhelmingly associated with drought years. Drought has contributed both proximately and ultimately to these declines. Proximately, dehydration and starvation result in elevated mortality. Ultimately, drought likely contributes to other factors that are directly responsible for tortoise mortality, such as mycoplasmosis and increased depredation.

While the desert tortoise is adapted to seasonally dry conditions and periodic annual drought, frequent drought years within a relatively short period result in high mortality rates, reduced reproduction, reduced individual growth (leading to delayed reproduction), and reduced recruitment. These factors are discussed relative to population recovery.

Preliminary Results of the Desert Tortoise Survey of the Jawbone-Butterbredt Area of Critical Environmental Concern

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The Jawbone-Butterbredt Area of Critical Environmental Concern (ACEC) is located in the northwest Mojave Desert, outside of critical habitat for the desert tortoise (*Gopherus agassizii*). In 2002, a long-term project was established to establish baseline data and monitor status and health of the ecosystem. Objectives for the desert tortoise included: (1) developing a protocol for monitoring tortoise populations on public lands used for off-highway vehicle (OHV) recreation, (2) developing a statistically valid technique for determining distribution and abundance for the species in areas (such as the ACEC) with low to very low densities, (3) determining abundance and distribution of the tortoise and potentially important habitats within the ACEC, and (4) evaluating historical and ongoing anthropogenic uses and their relationships to tortoise abundance. We stratified the ACEC by such attributes as vegetation, topography, and human uses, and then selected 777 one-hectare plots using a systematic random sampling method. Two field biologists searched each plot independently for tortoises and sign and also recorded data on human-related uses. Thirty-six percent of the plots (N = 277) have been surveyed. Live tortoises and sign were found on 25 (9%) in two clusters: a 12 km^2 area in the foothills of the Scodie Mountains, and a similar-sized area in and adjacent to Red Rock Canyon State Park. Signs of human disturbance were on every plot. The most common signs were cattle scat (92% of plots), garbage (60% of plots), off-highway vehicle tracks (52% of plots), and bullet casings (47% of plots). Plots with tortoise sign had fewer cattle scat than plots without tortoise sign (ANOVA; F = 13.286, df = 274, $P <$ 0.0005). The survey will be completed in summer of 2004. We thank the California State Off-Highway Vehicle Commission for financial support.

Effectiveness of Desert Tortoise Recovery Actions: A Review of the Supporting Evidence

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Modern wildlife management strives to base practices on science. However, management actions cannot wait for scientific knowledge to accumulate, and are made with the best available science at the time, which can cause later difficulties when management actions are challenged. We investigated the scientific basis for recovery actions used for desert tortoises, both to determine its coverage (i.e. are there studies that address the effectiveness of recovery actions used today?) and its reliability (i.e. are the studies available scientifically defensible?). We collected peer-reviewed journal articles, unpublished reports, and other forms of information desert tortoise managers use to support their recovery actions, and evaluated topics addressed and major findings. Additionally, we compared each study to general criteria for reliability of scientific studies (e.g. the most reliable studies use experimental manipulation, randomization, replication, and controls whereas deviations from these practices reduce reliability). We found that studies of threats to tortoises are fairly common. However, since reduction in a single known threat for a species limited by multiple threats (such as road mortality and raven predation) may not result in recovery, we considered reduction in threat to be a necessary but not a sufficient demonstration of effectiveness of a recovery action. Studies of effectiveness of recovery actions are rare, and we found no study that experimentally demonstrated a tortoise population recovery following a recovery action. We propose a series of increasingly stringent assumptions that must be made for observations of reduced threats to be considered recovery, so that existing studies can be better placed in a recovery context.

STUDENT PAPER

Mapping the Location, Habitat, and Characteristics of Eastern Mojave Desert Tortoises Encountered during NPC Construction and Maintenance Activities

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Nevada Power Company (NPC) has begun upgrading their transmission system in Southern Nevada to increase reliability and support the growing demand for electricity. Recently completed transmission lines are located in Ivanpah Valley, from Primm, Nevada to southwestern Las Vegas Valley and along the northern end of the Las Vegas Valley from Apex to Northwest Las Vegas Valley. The permitting and construction of

new transmission lines has required Nevada Power Company to employ biologists to survey and monitor and consequently collect data pertaining to the Mojave Desert tortoise. The monitors have recorded the location, size, and sex any Mojave Desert tortoise encountered in or near construction projects along with data from other sensitive species. Data from biological monitors' field notes were collected and the location of Mojave Desert tortoises were mapped using Geographical Information Systems to identify density of Mojave desert tortoises within varied habitats of Nevada Power Company's project areas. Areas of new construction were located in the periphery of the growing Las Vegas Valley and urban growth is expected to continue outward as the Bureau of Land Management releases land for development. This fact, combined with the age structure of the population we observed indicate the Mojave Desert tortoise population will continue to decline in this region of Southern Nevada.

Home Range and Movements of Sonoran Desert Tortoises At A Long-term Study Site

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A population of Sonoran desert tortoises at Sugarloaf Mountain in the Tonto National Forest has been the subject of an ongoing long-term reproductive ecology project. From 1996 to present, we have collected weekly locations on telemetered tortoises. To date, we have marked 135 tortoises at the site and recorded 8016 tortoise locations. Historically, Minimum Convex Polygons (MCP's) had been used to delineate individual tortoises home ranges. We are using kernel analysis, a probability density estimation approach to determining home range, to determine core areas and potential movement patterns of telemetered tortoises. Preliminary analysis shows that some males make seasonal movements from their hibernacula to areas where known females occur, while other males reside within the home range of several females and so do not engage in these seasonal movements. The availability of adequate shelter sites, primarily for hibernation, could be a causal factor for these forays undertaken by some males. Results from these preliminary analyses will be discussed during the presentation.

Accomplishments of the Red Cliffs Desert Reserve—A Partnership Success Story

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Administrator - Red Cliffs Desert Reserve
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The Red Cliffs Desert Reserve ▪ only eight years old ▪ has accomplished many meaningful projects on the ground that have benefitted tortoises, people and wildlife. Partners consist of the BLM, USFWS, Utah Division of Natural Resources (UDNR), Utah State Parks, Washington County and various cities and organizations. Specific results include: an education outreach program; the construction of 45 miles of fencing;

the establishment (by UDNR) of a scientifically based tortoise monitoring program; the translocation of 215 tortoises to an isolated part of the Reserve; the clearance and removal of tortoises from over 4,500 acres of developed habitat outside the Reserve; the improvement of Reserve design (boundaries) in six places; the publication of a first rate map generating community ownership; a long term public use plan for recreation; the implementation of a human impact monitoring plan by Northern Arizona University; the centralization of utilities within corridors to reduce habitat fragmentation; construction of an education center; the establishment of 13 trail heads to control access to sensitive habitat; the posting and marking of 62 miles of trails to encourage people to stay on trails; the installation of 19 bulletin boards with enlarged maps showing Reserve access; the procurement of 7,955 acres of private properties inside the Reserve; the receipt of over 20 million dollars of federal funding to purchase private property; surveys of birds of prey and the preservation of a unique pioneer site.

STUDENT PAPER

Apparent Female Choice in a Population of Desert Tortoises in the Central Mojave Desert, California

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In 2003, I began the first field season of a study investigating apparent female choice at a remote study site on Fort Irwin. This project is part of a larger multi-year study, conducted by the USGS-BRD, to explore tortoise social behavior in an area free from human impacts. Understanding female choice is important in deciphering the social structure of this population. The specific question that is being explored is whether female desert tortoises in this population show a preference to mate with particular male tortoises. Do female tortoises elicit courtship from certain male tortoises, while actively rejecting the advances of other male tortoises?

I tracked 6 female tortoises, fitted with radio transmitters, at a study site on the eastern border of Fort Irwin. Observations were done over a total of 38 days between late July and early October. This period corresponds to the peak of mating activity when male testosterone levels are at their highest. The recording methods used included a combination of behavior sampling in conjunction with focal sampling. Behavior was divided into clearly defined categories based on information from previous behavioral studies at the study site (USGS), a published ethogram based on desert tortoises in semi-natural conditions (*Herpetological Monographs,* No. 8), and information gathered during a preliminary observation period. Behavioral patterns that likely indicated female acceptance or rejection were used (e.g., coming out of coversite for a courting male, continuously turning shell away from the advancing male, dropping shell tightly to the ground, quickly seeking refuge under a bush or coversite, lifting shell up for a courting male, etc.).

I observed few actual matings. There were many instances when a male and female were located close together, but were apparently unaware of each other. Other times, two individuals associated with each other for extended periods (sometimes days), but no mating took place while I observed.

Often times, a female tortoise remained in her coversite while a male courted her at the cave's entrance. Because males are generally much larger than females, females can select caves too small for males to enter. The best the male could hope for in this situation is for the female to accept his advances and come out of her cave. This would be a clear sign of female choice, and I've observed this on occasion.

The Common Raven as a Threat to Desert Tortoise, West Mojave Desert, California

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The common raven (*Corvus corax*) is a subsidized predator of the desert tortoise (*Gopherus agassizii*). Raven predation on juvenile tortoises is believed to be one of the most important threats to desert tortoise. Although many threats to the desert tortoise are known, few, including raven predation, have been quantified, which is essential to conservation management. An area in the West Mojave Desert encompassing four Breeding Bird Survey (BBS) routes was chosen for study. Raven population increases since the 1970's were calculated for this area. Using GIS, features in this landscape identified as "raven attractants" were quantified. Spatial and statistical analyses were used to estimate and rank the importance of various "raven attractants" (landfills, water sources, urban areas, etc.) in their potential to increase local raven populations. The results of this study can be used in adaptive management of desert tortoise through management of "raven attractants".

Status of the Desert Tortoise in the Red Cliffs Desert Reserve

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The Upper Virgin River Recovery Unit, managed as the Red Cliffs Desert Reserve (Reserve), is located in southwest Utah, Washington County. The Reserve represents the northeastern extent of the desert tortoise's geographic distribution. The Reserve contains 38,787 acres of Mojave desert tortoise habitat and its primary goal is to maintain a stable or increasing tortoise population in perpetuity. It is considered a highly threatened population due to its proximity to urban growth and small size.

The Utah Division of Wildlife Resources has been intensively monitoring tortoises in the Reserve since 1998. In 2003, full-scale tortoise monitoring revealed a density estimate of 0.17 tortoises per ha (0.12-0.22) within Management Zone 3 of the Reserve and a density estimate of 0.17 (0.13-0.22) throughout the Reserve. Current estimates in 2003 show a 47% population decline within Zone 3 and a 41% decline throughout the Reserve since tortoises were regionally monitored in 1998. Both estimates show a biologically significant downward trend.

Several demographic parameters including shell remains, growth rates, and health assessments were observed as a byproduct of monitoring. The number of shell remains observed in 2003 increased dramatically. The majority of shell remains found were in areas with high relative tortoise densities. These shell remains showed no evidence of predation and died within one year. The status of tortoise translocation within Management Zone 4 as well as culvert monitoring will also be presented.

STUDENT PAPER

Can Modeling of Tortoise Activity Be Used to Improve Species Monitoring?

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Desert tortoises are currently the focus of a large, multi-state monitoring program that uses distance sampling to estimate population densities from line-transects. A critical assumption of this technique is that all animals on or near transects are observed. Because desert tortoises spend large proportions of the year in burrows, this assumption is frequently violated. Therefore, the density calculation requires a correction factor to account for the proportion of animals active and available to be counted (Go) to account for the under-sampled proportion of the population. Estimating Go is currently accomplished by monitoring a small number of animals (N = 6-12), which are scored for behavior several times daily during the transect-sampling period. Collecting these data is very costly, and lacks precision due to the small sample sizes currently monitored. To explore the influence of environmental variables on tortoise activity, we are modeling the link between biophysical attributes of the environment and the proportions of tortoise that are active. These models are based upon empirical observations of ~120 tortoises monitored over a three-year period. The model inputs include: environmental temperatures, operative temperatures, rainfall, solar radiation, among others. We employ a fusion of biophysical and neural network modeling to allow for, and benefit from, the complex interactions existing among the environmental variables included in the model. We present an initial model that identifies influential environmental variables affecting activity, and explore the repeatability of tortoise activity among days with similar environmental conditions. Our data show that activity may not be a highly repeatable

behavior, which will make modeling efforts difficult. We are conducting further research to refine our ability to predict tortoise activity.

Sonoran Tortoises Foraging After Summer Rains Consume Low PEP Diets

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The opportunity to drink rain water permits the desert tortoise to rid the body of excess potassium via fluid urine. In such circumstances, tortoises do not need to degrade protein to produce potassium urates, so that the Potassium Excretion Potential [PEP] index of food plants becomes less important. We hypothesized that Sonoran desert tortoises that foraged after summer rains would not need to be selective with regard to the PEP value of food plants, and could consume a low PEP diet without adverse effect.

The foraging behavior of 6 adult radiotelemetered tortoises was observed August 11-18, 2002, at Ragged Top, Ironwood Forest National Monument, Pima County, Arizona. Six tortoises were observed to take more than 18,500 bites of 2342 plants representing 31 identified plant species. The diet was comprised of 51.3% bites of grasses (annual and perennial), 25.8% bites of summer annual forbs, 19.8% perennials (including shrubs and vines), and 3.2% bites of senescent material and bone. The top 5 plants eaten were a dual-season annual grass (6-weeks three-awn, *Aristida adscensionis*, 33.1% of bites), a euphorb subshrub (*Ditaxis lanceolata*, 12.3%), a summer annual euphorb (*Chamaesyce florida*, 11.0%), summer annual grama grass (*Bouteloua* spp., 9.8%), and a summer annual spiderling (*Boerhavia intermedia*, 6.5%). Two to six samples were collected of each food plant species (n=29) for analysis of water, protein (TN x 6.25) and potassium, from which the PEP Index was calculated. Plants of high PEP indices (PEP = 10-17) comprised 20% of bites, but only a few species appeared to be preferred relative to abundance along foraging paths. Plants with negative PEP indices comprised a substantial portion (11.4%) of bites. The overall diet, weighted by number of bites per plant species, was calculated to contain 61% water, 15% protein, 2.5% potassium and a PEP index of 1.1. By comparison to the spring diet of juvenile tortoises in the central Mojave Desert, this diet was low in water (61 vs. 72%), high in protein (15 vs. 11%), very high in potassium (2.5 vs. 1.4%), and very low in PEP (1.1 vs. 15). These data are consistent with the hypothesis that tortoises foraging after summer rains do not need to seek out high PEP plants as they have sufficient water available for excretion of excess potassium.

Microbial Communities in the Nasal Passages of Healthy and URTD Tortoises

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Natural communities of microorganisms are believed to provide an important barrier to infection by potential pathogens. We characterized the microbial communities in the nasal passages of desert tortoises (*Gopherus agassizii*) quantitatively to determine if there are individual or seasonal variations, or differences between healthy tortoises and those with symptoms of upper respiratory tract disease (URTD). We studied 12 captive tortoises at the Adobe Mountain Wildlife Rehabilitation Center in Phoenix, Arizona. The tortoises were divided into four groups: three healthy tortoises were sampled monthly, three URTD tortoises were sampled monthly, three healthy tortoises were sampled bimonthly, and three healthy tortoises were sampled once. At each sampling time, the tortoises were examined for general health and weight, and both nares were probed with moistened sterile swabs. The bacteria on the swabs were suspended in sterile saline, serially diluted, and plated on tryptic soy agar medium. Total bacterial counts/ml varied from tortoise to tortoise, increased from May to August and decreased from September to November. Total counts were usually higher in URTD tortoises. The microbial communities were dominated by pigmented Gram-positive cocci, and Gram-positive rods and coryneforms also were found. The proportions of different bacteria varied from month to month and did not differ substantially between healthy and diseased animals. There was no indication that monthly sampling affected the microbial communities. These studies suggest that a broader ecological and microbiological analysis of these communities would be valuable.

Identification and Characterization of the Antigen Presenting Cells' (APC) Receptor CD74 of Mediterranean and Desert Tortoises: Implications in Diagnostic and Health Assessment

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During the last decade, reptile medicine has dramatically improved in almost all its branches from diagnostic to therapy and surgery. Nevertheless, the field of reptile immunology has been virtually untouched since the late 70's. Additionally, the extraordinary improvement that human medicine has benefit from the growing knowledge concerning the functions and the structures of the human immune system clearly demonstrate that new efforts need to be done to fill this gap in reptile medicine.
In an attempt to acquire some basic data about the molecular players that are pivotal for the functions of the reptile immune system, a complementary DNA (cDNA) library from Testudo graeca Ficoll®-purified total white blood cells was prepared. More than a

hundred clones were identified and submitted for sequencing. During the sequencing of a first batch of 20 cDNA clones that have been obtained, the antigen presenting cells (APC) receptor CD74 was identified. This cellular receptor is known to be expressed on the surface of all the antigen-presenting cells, particularly on B-lymphocytes and Macrophages. Additionally, CD74 is known to be structurally associated to the immature forms of the major histocompatibility class II (MHCII) molecules that are involved in the antigen presentation to the CD4+ T-lymphocytes. In human immunology CD74 has been characterized as a critical chaperone molecule in directing the correct folding of the MHCII molecules. Additionally, CD74 is critical in the loading of the not-self peptides that are derived from the intra-vesicular degradation of phagocitated microorganism by the APC cells in the MHCII groove itself.

In the attempt to acquire more information concerning the variability and polymorphysm of CD74 in other chelonians, the homologous regions of *T. hermanni, T. marginata* and *Gopherus agassizii* CD74 were successfully amplified by polymerase chain reaction (PCR) using two primers which were designed on the sequencing information obtained for T. graeca CD74. The comparison of the homologous regions of the CD74 receptor of these four tortoises species showed that this molecule is very conserved in chelonians.

We are currently evaluating if the distribution of this receptor in lymphoid tissues from healthy and diseased tortoises, in the attempt to assess if it is possible to use CD74 as a marker of inflammation and disease.

CD74 is the first ever cell receptor identified in reptiles. The identification of the Mediterranean and Desert tortoises CD74 suggests that reptiles too shares the basic immune response dynamics that have been described in mammals and in humans. The study and the characterization of molecules such as CD74 could reveal the basic functions that control immune response in reptiles and could be used as very specific diagnostic tools to assess the integrity and the efficiency of the immune response itself.

Center for Biological Diversity Works for Tortoise Recovery: Challenging BLM Plans, FWS Biological Opinions & Bush

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In 1976, Congress designated a 25 million acre swath of Sonoran, Mojave and Great Basin deserts — stretching from the Mexican border north to Death Valley and the eastern Sierra Nevada Mountains — as the California Desert Conservation Area (CDCA). The CDCA includes some of the most scenic and biologically important areas in Imperial, San Diego, Los Angeles, Riverside, San Bernardino, Kern, Inyo and Mono counties. This Virginia-sized expanse was entrusted to Bureau of Land Management (BLM) to be forever protected for wildlife, open-space, sustainable use and human enjoyment.

BLM's 11 million acre share of the CDCA contains 3.4 million acres of habitat designated critical to the survival and recovery of the threatened desert tortoise *(Gopherus agassizii)*.[1] The CDCA is also harbors 23 other federally protected threatened or endangered species including Peninsular Ranges bighorn sheep, Inyo California towhee, desert pupfish, Coachella Valley fringe-toed lizard and rare plants such as Cushenberry oxytheca, Amargosa niterwort and Peirson's milkvetch.

These 24 species and the entire ecological health of the CDCA are jeopardized by new BLM plans which favor the historic status quo of mining, livestock grazing, road building, utility projects, and off-roading. Imperiled species, such as the desert tortoise, are declining as regional planning efforts short-change wildlife by not implementing recovery plans.

In late 2000 and early 2001, The Center for Biological Diversity (CBD), Public Employees for Environmental Responsibility (PEER), the Sierra Club, and five off-road groups settled a landmark lawsuit with BLM over its failure to follow the Endangered Species Act. In the settlement BLM agreed to: prohibit mining expansions or new mines on all designated or occupied T&E species habitat within the CDCA; reduce or prohibit livestock on 1.9 million acres; prohibit ORVs on 550,000 acres of sensitive habitat areas-including 49,310 acres of the Algodones Sand Dunes; route designation on 874,000 acres of the West Mojave; complete desert wide route designation by 2004; and other conservation and recovery measures.[2] The CDCA settlement had BLM implementing some on-the-ground recovery actions – but its balanced management is abandoned as BLM rolls-back protections across millions of acres.

Aided by U.S. Fish and Wildlife Service (FWS) no-jeopardy biological opinions, BLM has approved final Northern and Eastern Colorado Desert Plan (NECO), Northern and Eastern Mojave Desert Plan (NEMO), Coachella Valley Plan, Western Colorado Desert Routes of Travel Plan (WECO), and Algodones (Imperial) Dunes Plan, but all these plans fall far short of species and habitat recovery needs. Species recovery plans are not implemented, despite a finding by GAO that the tortoise plan is based on sound science. With the proposed Ft. Irwin expansion lurking, and an aggressive anti-environmental administration, the abandonment of the minimum species recovery shield provided by the CDCA settlement represents a dangerous roll-back in wildlife protection. The settlement remains in place within the West Mojave (WEMO) planning area until plan completion. The roll-back of conservation through these BLM plans forced new litigation against Interior, especially challenges to flawed FWS biological opinions.

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[1]U.S. Fish & Wildlife Service, final rule (59-5820), *Federal Register*, 2/8/94.

[2]Center for Biological Diversity, Legal Settlement Protects 24 Endangered Species on 11 Million Acres, *www.biologicaldiversity.org/swcbd/goldenstate/cdca/settlement.html*

The Effects of Roads on Snakes

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In this presentation, we summarize information on the direct and indirect effects of roads on snakes and some of the actions that can be taken to mitigate these effects. The basis for this presentation is a review of approximately 30 papers from the peer-reviewed and gray literature. Several snake characteristics may contribute to their susceptibility to road mortality, including their relatively long seasonal movements between required habitats (e.g., overwintering and foraging areas), behavioral thermoregulation utilizing road surfaces, elongate body shape, and negative perception by motorists. Species that are more vagile are generally more likely to suffer from road mortality. Direct effects of roads include the killing of snakes by vehicles and road construction activities. One study documented 13,000 road-killed snakes, and several other studies have documented hundreds of snakes killed on roads. Some studies also indicate that road mortality is having negative population level effects. Blasting involved with road construction is known to have affected communally overwintering snakes. Indirect effects of roads may include influencing snake movements, habitat fragmentation and alteration (e.g., changes in temperature, moisture, light, noise, and pollutants), changes in prey and predators, and increased access for collectors. Mitigation activities include changing the placement of roads during planning, warning signs, seasonal road closures, and the construction of road-crossing structures (fences, tunnels, bridges, etc.). The correct placement of such mitigation efforts is critical to their effectiveness.

Department of Fish and Game and the Desert Tortoise, Our State Reptile

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Since 1939, state laws have been in place to protect the desert tortoise. In August of 1989, the tortoise was officially listed as Threatened. The Department's mandate for protecting the tortoise is the California Endangered Species Act. Section 2081 of the Fish and Game Code, allows take with a permit for scientific, educational, management, or incidental take to an otherwise lawful activity provided the take is minimized and fully mitigated. In addition to the Take Permit, a Memorandum of Understanding for Handling Tortoises is needed and we must review the qualification of each person who applies for the MOU. The Department also issues Scientific Collecting Permits for research and studies on desert tortoise and permits for Possession of Captive Tortoises.

The Department, through the CESA permitting process, and by other means, has acquired over 30,000 acres of desert lands within recovery units. Along with the land, the Department has also collected enhancement and endowment fees for management of the lands. Fencing has been installed in some of the areas to exclude cattle grazing and OHV use. In addition to the lands that have been acquired by the Department, some mitigation lands have been acquired by the Desert Tortoise Preserve Committee and others have gone to the Bureau of Land Management.

In 2003, the Department worked with local jurisdictions to aid them in complying with the California Environmental Quality Act and the California Endangered Species Act. Compliance inspections on Incidental Take Permits issued have been increased, especially on large projects such as Interstate 15 widening projects and Kern River Pipeline. We worked on permitting several large projects, with the largest being a test track of Hyundai in Kern County. The Department spent significant time and resources in review and commenting on the Draft EIS/EIR for the West Mojave Plan.

This past year the Department also funded blood work and necropsies for health and disease information. Law enforcement activities continue to result in the seizure of illegally possessed tortoises and removal of feral dogs. We are continuing to work with the California Tortoise and Turtle Club to improve permitting for captive tortoises.

Conservation and Management of Sonoran Desert Turtles

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Five species of turtles are associated with the Sonoran Desert of Arizona, and all are species of interest either at a state or federal level. One species, the Sonoran desert tortoise *Gopherus agassizii* and one subspecies, the Sonoyta mud turtle *K. s. longifemorale*, are the subjects of multi-agency conservation agreements. Conservation agreements and strategies are a relatively new tool used to address specific known threats in order to preclude the need to list a species. In 1990 the Mojave population (all tortoises north and west of the Colorado River) of the desert tortoise was listed as threatened under the Endangered Species Act. Based on available data, the United States Fish and Wildlife Service ruled that listing the Sonoran population (tortoises south and east of the Colorado River) was not warranted. The Sonoran population is considered a species of special concern by the Arizona Game and Fish Department, and a State Conservation Agreement and Strategy is being constructed by the Arizona Interagency Desert Tortoise Team. The Sonoyta mud turtle, a candidate species for federal listing, is only known from the Rio Sonoyta drainage of extreme northern Sonora, Mexico, and Organ Pipe Cactus National Monument, Pima County, Arizona. A multi-species Candidate Conservation Agreement including the turtle, an endemic spring snail, and pupfish is under construction by both state and federal agencies in Mexico and the United States.

Desert Tortoise Management in Arizona

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The listed Mojave population of the desert tortoise occurs in Arizona only in the extreme northwest corner of the State north of the Colorado River, a relatively small area within the Northeast Mojave Recovery Unit. The Arizona Game and Fish Department (AGFD) continues to work closely with the Bureau of Land Management (BLM) and the U.S. Fish and Wildlife Service to monitor the population status of tortoises within this region through both plot monitoring and distance sampling. Habitat management is covered primarily by BLM's Arizona Strip Resource Management Plan, which was prepared to implement the Mojave population's recovery plan. Additional management actions are needed to address threats related to highway mortality and disease.

In the Sonoran Desert, AGFD and many cooperators continue to monitor population trends and conduct research on the ecology of this population to provide information to better manage the Sonoran tortoise and preclude the need to list under the Endangered Species Act. This research also provides comparative data that may contribute to recovery and management actions for the Mojave population. Members of the Arizona Interagency Desert Tortoise Team are beginning development of a State Conservation Agreement to further ensure the status of the Sonoran population.

Wilderness Restoration and Inholding Acquisition in the Bureau of Land Management's California Desert Conservation Area: Implications for Desert Tortoise Habitat

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The Bureau of Land Management (BLM) manages 3.7 million acres of wilderness in the California Desert Conservation Area (CDCA), 630,000 acres (17%) of which is desert tortoise critical habitat (DTCH). Some vehicle ways within wilderness have been treated to create a "visual barrier" and thus reduce the frequency of vehicle incursions. Examples of treatments will be shown. As part of the implementation process for the California Desert Protection Act of 1994, the BLM has acquired approximately 200,000 acres of lands from willing sellers. About 46,000 acres (23%) of the acquired lands are in DTCH. Such consolidation of ownership makes management of both public and private

lands more efficient and reduces the incidence of developments in wilderness areas and DTCH.

A Laser Ablation ICP-MS Technique for Examining Elemental Distribution in Scute Tissues of Desert Tortoise Shells

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Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) is a microanalysis technique capable of performing spatially-resolved measurements of elemental concentrations in a wide variety of solid samples. LA-ICP-MS has proven to be particularly useful for the examination of incrementally-grown biological structures such as teeth, mollusk shells, and fish otoliths. Patterns of elemental concentration, revealed in this manner, often exhibit seasonal periodicity as well as correlation with environmental and climatological change. The scutes on desert tortoise (*Gopherus agassizii*) shells offer an opportunity to evaluate elemental uptake chronologically. The growth rings on individual scutes consist of keratin in which various metals and metalloids are sequestered during early development and growth.

We tested three different approaches and ultimately determined that the ablation transects should be performed on the exposed lateral surfaces of sectioned scutes. This approach successfully avoids exogenous contamination from the scute exterior. Under these circumstances, the laser microprobe appears to encounter a succession of discrete laminae (e.g., from areola to the most recently produced ring), in order of deposition. Results obtained thusfar indicate that patterns of zinc concentration provide a potentially useful “map” of the scute interior, as well as a spatial reference for the distribution of other elemental species. Patterns of arsenic concentration from scutes of tortoises ill with mycoplasmosis and cutaneous dyskeratosis exhibited distinct concentration maxima at specific locations along the laser ablation transect axis. The results presented here illustrate the utility of laser ablation ICP-MS techniques for providing analytical data having unique chronological aspect, a timeline implicit in the structures, and substantial diagnostic significance for the tortoise.

BANQUET ADDRESS

In Search of the Angonoka Tortoise of Madagascar

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The diverse reptile fauna of Madagascar includes four endemic tortoises, *Geochelone yniphora*, *G. radiata, Pyxis arachnoides*, and *P. planicauda*. Two giant tortoises, *Dipsochelys grandidieri* and *D. abrupta*, were extirpated from Madagascar following the arrival of humans, most likely as a result of over-hunting and habitat alteration. None of the living species are well known, and all four species are threatened by human activities. In 1993, I traveled to Madagascar to begin the first long-term field study of the angonoka (aka ploughshare tortoise), the most endangered of the four living species. The angonoka has been bred in captivity since the mid-1980s, but little was known of its status and ecology in the wild. The angonoka tortoise occurs in bamboo-scrub forest in western Madagascar and all known populations occur within a <100 km^2 area around Baly Bay. I spent two years searching for previously unrecorded tortoise populations and lived and worked on the tiny peninsula of Cape Sada. A travelogue of Madagascar along with an overview of the status and ecology of the angonoka tortoise will be presented.

Mitigation for Wildlife Mortality on a Highway through Paynes Prairie State Preserve in North-Central Florida

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There have been numerous reports of significant mortality of amphibians and reptiles on U.S. Highway 441 across Paynes Prairie in Alachua County, Florida. In addition to mortality of individual animals, the roadway was thought to act as a nearly impenetrable barrier to movements of some species. Although snakes and frogs comprised the majority of kills, more than 60 species of vertebrates have been reported killed on this 3.2 km stretch of highway. In 2000, the Florida Department of Transportation began construction of a barrier wall and underpass system (ecopassage) to reduce wildlife mortality by directing snakes and other vertebrates through culverts beneath the road. Prior to construction of the ecopassage system, we conducted a year-long survey to determine pre-construction mortality levels. These data, and those of a post-construction survey, were used to evaluate the effectiveness of the ecopassage system in decreasing or preventing vertebrate mortality. During the post-construction survey, we counted only 158 animals, excluding hylid treefrogs, killed in the same area where 2,411 road kills were recorded in the 12 months prior to the construction of the barrier wall-culvert

system. The 24-hour kill rate during the post-construction survey was 4.9 compared with 13.5 during the pre-construction survey. We detected 51 vertebrate species, including 9 fish, using the 8 culverts after the construction of the barrier wall-culvert system, compared with 28 vertebrate species in the 4 existing culverts prior to construction. Capture success in culverts increased 10-fold from the pre-construction survey to the post-construction survey.

BLM Arizona Talking Points

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In Arizona, >80% of the desert tortoise population is within the Arizona Strip boundaries. We will discuss the following desert tortoise topics, including management plans, recovery plan, major accomplishments, current status, the Mojave and Sonoran populations, grazing impacts, areas of critical environmental concern, and population declines.

C. R. Tracy et al. NO ABSTRACT PROVIDED

Desert Tortoise Clearance Surveys Using Scent Detector Dogs: Protocols, Efficacy, and Future Applications

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Accurate and economic wildlife census techniques have become increasingly important as human development continues to encroach on the habitat of threatened and endangered species. Lands that are slated for development often require mitigation based upon their habitat quality. One mitigation strategy is the relocation of imperiled species to wildlife preserves. Counting and retrieving individuals can be exceedingly difficult for a species such as the desert tortoise that is cryptically colored and spends much of its life inactive in burrows or dense vegetation. In January 2004 we systematically evaluated scent detector dogs at surveying for tortoises and identifying occupied burrows. Work was conducted at the Hyundai Test Track near Mojave, CA in the western Mojave Desert. Detector dogs were first tested on their abilities to locate 19 radio-tagged tortoises in winter hibernacula, then used to survey approximately one square mile of proposed development. The application of this technique to future desert tortoise surveys will be discussed.

Using Automated Radio Telemetry to Monitor Wildlife Activity

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Automated radio telemetry equipment is currently being used to study the activity patterns of desert tortoises at the National Training Center on Fort Irwin. This equipment can enable one person to monitor and document the activity of many animals continuously over an extended time, regardless of weather, light level or terrain. The basic approach is to record and analyze the radio signal received from a radio transmitter mounted on the study animal. Because of the directivity pattern of the transmitting antenna and the fact that variations in its juxtaposition to its surroundings change the radiated power, motion of the animal causes changes in the received signal. A recording of the temporal variation of the received signal contains considerable information about the movement of the animal. Interpretation of these signals is amenable to automated analysis by computer algorithms. Automated data analysis computer algorithms classify signals as active or inactive, based on moving averages of changing signal amplitude. Activity data, in conjunction with meteorological data, are being recorded to provide detailed temporal information on when tortoises are active above and below ground on a yearly basis. The automated telemetry system also measures and records temperature at the transmitter. Data from this research project should benefit the recovery and management of desert tortoise populations through refinements in a number of research areas, e.g., temperature-based tortoise handling guidelines, line distance sampling, and translocation.

The Clark County Desert Conservation Program: 2001-2003 Biennium Accomplishments

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The Clark County Desert Conservation Program stems from the 1989 Federal listing of the desert tortoise as a threatened species. Since that time, the program has evolved through development and implementation of a Short-term Desert Conservation Plan for desert tortoise, a Long-term Habitat Conservation Plan for desert tortoise, and finally, effective in January 2001, the Clark County Multiple Species Habitat Conservation Plan (MSHCP). The MSHCP covers the desert tortoise and 78 other species.

Clark County has recently completed the first full biennial cycle of conservation funding for the MSHCP. As plan implementation has progressed, two of the most challenging aspects of program management are: 1) Developing, implementing, and refining program-specific adaptive management principles and practices, and 2) Increasing our ability to monitor the effects of management actions and the effectiveness of conservation actions, including habitat restoration, species and habitat inventory, and research activities.

As part of the Desert Tortoise Council panel addressing management issues, this brief talk will provide a summary of desert tortoise-related conservation actions accomplished during the 2001-2003 biennium and provide an update on the status of adaptive management and effectiveness monitoring for the Clark County program.

Defenders of Wildlife and Desert Tortoise Conservation

Cynthia Wilkerson
California Species Associate, Defenders of Wildlife

This talk will focus on the history and current status of Defenders of Wildlife's work on desert tortoise conservation. Richard Spotts worked actively for the tortoise from 1979 to 1993. This work included major grassroots organizing and Congressional lobbying campaigns for conservation lands in the California desert, support of the California state Endangered Species Act listing, the Federal Endangered Species act listing, the designation of critical habitat, and the development of the U.S. Fish and Wildlife Service Recovery Plan. Following a nearly decade long hiatus, Defenders has again dedicated staff time and funding towards work in the California desert, with desert tortoise conservation as a major focus. Defenders current desert tortoise work focuses on pushing for implementation of the recovery plan in various planning efforts in California. State and national advocacy, working directly with the USFWS, public education and media efforts are the main strategies employed. This work will continue into the future with increased public scrutiny on the plight of desert tortoise conservation in California.

Progress Report for Nevada and California with a Summary of the Recovery Plan Assessment Process

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The U.S. Fish and Wildlife Service is responsible for administering the Endangered Species Act including oversight of recovery efforts. USFWS reports on the status of desert tortoise recovery to the Desert Tortoise Council, Desert Managers Group, and Management Oversight Group (MOG) on an annual basis, at a minimum. USFWS serves as the chair of the MOG.

Highlights of 2003 include the commitment of USFWS to assess the 1994 Desert Tortoise Recovery Plan. The Desert Tortoise Recovery Plan Assessment Committee (Committee) was organized in March of 2003. The charge of the Committee is to review the entire Recovery Plan relative to contemporary knowledge and, based on that review, prepare recommendations on Recovery Plan updates. The Committee met monthly since April 2003, and is scheduled to present their recommendations to the MOG in March 2004. A brief overview of the Recovery Plan assessment process will be presented.

In 2003, the MOG met in Las Vegas on February 12 and September 24. At the February meeting, USFWS provided a summary of the findings and recommendations of the December 2002 GAO report to Congress. A progress report on the Recovery Plan assessment was presented by members of the Committee at the September meeting; reports were also given on the November 2002 disease workshop and activities of the Desert Managers Group.

Major desert tortoise consultations completed in 2003 include programmatic biological opinions issued to the BLM in Tonopah, Nevada and U.S. Air Force, Nevada Test and Training Range. Our Ventura Field Office issued a non-jeopardy biological opinion on route designations in the western Mojave Desert and an incidental take permit for development of an automobile test track near California City on approximately 4,000 acres. Ventura staff met with Caltrans and developed criteria for prioritizing installation of desert tortoise exclusion fencing along highways. Consultations are in progress for expansion of Ft. Irwin and the West Mojave Plan. Construction of the Kern River Natural Gas Pipeline across desert tortoise habitat in California, Nevada, Utah, and was completed in 2003 with only one confirmed desert tortoise mortality. A total of 851 desert tortoise encounters occurred, of which 232 required handling. Unfortunately, 3 tortoises were collected and removed (poached) from the project site.

Litigation pending includes a challenge of the biological opinion issued to the BLM for their California Desert Conservation Area Plan. A 60-day notice of intent to sue was received regarding the Recovery Plan and designated critical habitat.

The process of developing an environmental assessment began with the goal to reduce the level of predation on desert tortoises by common ravens. USFWS biologists developed a standard form to provide to potential desert tortoise biologists and monitors on construction projects. Temperature guidelines for permittees and a radio transmitter tracking database were also developed. Rangewide desert tortoise population monitoring efforts continued in 2003 and are proposed for 2004.

In Nevada, the Clark County Desert Conservation Plan and Southern Nevada Public Lands Management Act funded desert tortoise projects including: Construction of desert tortoise exclusionary fence along highways, translocation of tortoises into a fenced 35 mi^2 experimental release site, research, and habitat restoration.