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THE DESERT TORTOISE COUNCIL

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ABSTRACTS

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

Population Patterns from Range-wide Monitoring of the Mojave Desert Tortoise

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Distance-sampling methods have been used since 2001 to sample large regions of the desert and to characterize abundance of Mojave desert tortoises larger than 180 mm midline carapace length. Sampling design has been fairly stable since 2004, although effort varies somewhat year-to-year and regionally depending on agency funding. The 2011 recovery plan for the Mojave desert tortoise requires scientifically credible evidence of positive population trends over a 25-year period in all recovery units before delisting can be contemplated. In addition, monitoring may provide an overall measure of the success of on-the-ground recovery implementation efforts, with regional trends in abundance providing a composite measure of effectiveness of all recovery activities in each tortoise conservation area. I describe population patterns in each recovery unit, with attention to the role of adequate funding and to interpretation of emerging trends in light of actual funding.

Desert Tortoise: Conserve, Protect, Recover

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The Center for Biological Diversity continues our conservation and recovery campaign for desert tortoise and its habitat in California, Nevada, Utah and Arizona through science-based advocacy, participation in administrative processes, public information and litigation. For over

20 years, the Center has consistently supported increased protections for the desert tortoise as the path to desperately needed species recovery. Currently, our desert tortoise protection campaign is focused on protecting habitat and animals from development of renewable energy projects in occupied habitat, mining, off-road vehicles, grazing and other destructive activities and development proposals. Some of the challenges for tortoise conservation that the Center has been focused on in the past year include: renewable energy projects; the development of the Desert Renewable Energy Conservation Plan in California; challenging more than a decade of cattle trespass in Gold Butte, Nevada, translocation plans in Nevada, Fort Irwin, and elsewhere; Clark County's proposed HCP revisions which seek an additional 215,000 acres of take; and implementation of the revised Desert Tortoise Recovery Plan. Despite the overall bleak picture of decreasing numbers and on-going habitat losses for the species, some successes have been achieved that may result in increased conservation, for example, the new route designation and plan amendment process in the west Mojave area of the CDCA, and the potential for permanent grazing retirements in CDCA under new statutory authority 43 USCS §1781a.

The California Deserts: Floristic Frontier or a Hotbed of Sacrifice?

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The California desert flora, treated here as the region represented by the Jepson Desert Manual (2002), includes the Great Basin Province east of the Sierra Nevada and Mojave and Sonoran Deserts. The desert flora is species-rich, encompassing 38% (2,430 taxa) of California's native taxa. In the past 9 decades, 280 taxa have been added to the flora, and the rate of new species discovery has increased in the past 3 decades. By the end of this century, 150-230 native taxa are expected to be added to the flora, with the majority being newly described species that are also rare. In addition to numerous taxonomic discoveries, botanists continue to document significant range extensions and rare plant occurrences. Anthropogenic change is looming as the California deserts are being targeted for widespread renewable energy development (> than 2,000 sq. mi.) in the next five years. With approximately 10% of the flora undescribed and the documentation of rare species distributions incomplete, rapid and large-scale habitat destruction will profoundly increase the potential for extinctions. This presentation provides 1) an overview of recent plant discoveries and an assessment of our floristic knowledge, 2) the status of rare plants in the California deserts, and 3) a perspective of what we stand to lose with the impending industrialization of California's deserts.

The Future of the Desert Tortoise Conservation Center

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Historically, unwanted or found pet tortoises have dominated the resident collection and attention of the Desert Tortoise Conservation Center (DTCC). More recently, we have redirected

the focus of the DTCC such that it plays an important role in the range-wide recovery program for the Mojave desert tortoise. The current vision is to promote conservation of the desert tortoise and the Mojave Desert ecosystem by providing a first-class facility for applied conservation research, training, and education. Since partnering with San Diego Zoo Global for operation of the DTCC in 2009, we have made progress in assessing the health of tortoises and in furthering our understanding of disease, initiated research into population augmentation, offered training courses for professional biologists and field crews, and increased efforts to engage the public. A simple assessment of the relative application of DTCC activities to the four states within the Mojave desert tortoise's range suggests that almost ½ of the activities benefit California, with approximately 17% applying toward renewable energy projects in that state, and approximately ½ benefit Nevada. Lesser proportions apply toward Arizona and Utah (about 4% total). Unfortunately, we are now faced with shortfalls in funding that affect the DTCC's future. Existing funding available for operation of the DTCC, solely provided by the Nevada office of the Bureau of Land Management, is projected to be depleted by the end of 2014. As a result, we have initiated plans to close the DTCC by the end of that year. Such an outcome has several negative implications, including the loss of the only existing facility at which controlled, experimental research on disease is practically feasible, such as that of a new project funded by the National Science Foundation, and the inability to train biologists to conduct health assessments for translocation projects associated with renewable energy development. Nevertheless, we continue to seek solutions that will allow the DTCC to continue its role in desert tortoise recovery.

A Comparison of Desert Tortoise Populations and Habitat on Three Types of Managed Lands in the Western Mojave Desert

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We surveyed an area of ~260 km^2 in the western Mojave Desert to evaluate relationships between condition of Agassiz's desert tortoise populations (*Gopherus agassizii*) and habitat on lands that have received different types of management. The land management was of three types: public lands administered by the Bureau of Land Management (BLM) in the Rand Mountains and Fremont Valley in desert tortoise critical habitat, the federally designated and fenced Desert Tortoise Research Natural Area (DTRNA), and undeveloped and unoccupied privately-owned lands adjacent to the DTRNA recently acquired by a non-profit organization. We established 240 one-hectare plots using random sampling, with 80 plots in each of the three types of managed lands for a 0.92% sample. Surveys were conducted in spring 2011, and data were collected on live tortoises, shell-skeletal remains, other signs of tortoises, perennial vegetation, predators, and evidence of human use. The density for subadult and adult tortoises on all 240 plots was 5.46/km^2 (95% CI = 5.4–5.6). Densities for subadults and adults differed significantly by management area: 10.2/km^2 (95% CI = 9.9–10.4) for the DTRNA plots, 2.4/km^2 (95% CI=2.3–2.6) for the Rand Mountains and Fremont Valley; and 3.7/km^2 (95% CI=3.6–3.8)

for plots on private lands. Juvenile and immature tortoises were found only on the plots within the DTRNA. Counts of tortoise sign were highest on the DTRNA and lowest on private lands.

Logistic regression models indicated that presence of tortoise sign (live and dead tortoises, burrows, scat, etc.) was significantly and negatively affected by anthropogenic disturbances measured by counts of sheep scat, vehicle tracks, trash, and total disturbed surface area. Private lands had higher counts of vehicle tracks, sheep scat, and trash, as well as total amount of land with surface disturbances. The Rand Mountains/Fremont Valley management area (tortoise critical habitat) was intermediate in terms of counts of vehicle tracks and total disturbed surface area, and lowest in counts of trash and evidence of shooting. The DTRNA had lower counts of vehicle tracks and total disturbed areas than the other two management areas but higher counts of common ravens and sign of mammalian predators. Neither the Rand Mountains/Fremont Valley nor the DTRNA had appreciable evidence of sheep grazing. Factors potentially affecting recovery of tortoises varied by management area, and include sheep grazing, vehicle use, trash, the total of disturbed areas, and subsidized predators.

STUDENT PAPER

Juvenile Sonoran Desert Tortoise (*Gopherus morafkai*) Habitat Selection at a Long-term Study Site in Central Arizona, USA

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Biological diversity is threatened by increasing anthropogenic modification of natural environments and increasing demands on natural resources. Sonoran desert tortoises (*Gopherus morafkai*) currently have Candidate status under the Endangered Species Act due mostly to predicted habitat loss and fragmentation. An understanding of the ecology and habitat needs of Sonoran desert tortoises of all size classes is therefore necessary to properly manage the species and its habitat in Arizona, however, there is no published research on how juvenile Sonoran desert tortoises use and select for habitat. We investigated habitat selection of juvenile tortoises at the Sugarloaf Mountain (SL) study site in central Arizona, USA. We measured 22 microhabitat variables from 117 locations of 11 tortoises that had been tracked by radio-telemetry one to three times weekly between April 2010 and December 2011, including locations from the summer active season and during winter hibernation. We compared microhabitat at tortoise locations to an equal number of random SL locations to determine use and availability. Juvenile tortoises at the SL site use enclosed shelters on steep rocky hillsides with high proportions of sand and annual vegetation, and few succulents in summer. Tortoises used enclosed shelters on steep slopes for winter hibernation. We used results of tortoise microhabitat selection to inform a habitat suitability model in a geographical information system to classify habitat into a range of suitability for juvenile tortoises at this study site. An understanding of these features can allow managers to quantify Sonoran desert tortoise habitat needs and to understand the impact of land use policies.

Desert Tortoise Head-starting Project in Mojave National Preserve: An Update

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Because of the severity of population declines observed for desert tortoises, non-traditional management interventions such as head-starting are being explored as potential conservation tools to bolster remaining populations. The use of such non-traditional approaches has been extensively debated, with several authorities concluding that head-starting is not a resource-efficient mechanism for increasing population sizes. Although continual use of head-starting to maintain a declining population may not be a logistically feasible approach, temporary use of head-starting to augment a depleted population could potentially "jump-start" the population towards eventual recovery, provided that the threats causing the original decline have been removed or mitigated. In 2011, we initiated a long-term study to 1) evaluate the effectiveness of head-starting to increase juvenile survivorship and 2) subsequently increase recruitment and overall population size of resident tortoise populations in the Mojave National Preserve, CA. Therefore, our initial study is designed to compare growth, survivorship, and post-release spatial ecology of juveniles from the following three experimental treatments: 1) "direct-release" hatchlings from protected nests released into wild shortly after hatching, 2) "low rain supplemented" head-starts reared in outdoor enclosures receiving low levels of rain supplementation, and 3) "high rain supplemented" head-starts reared in enclosures receiving more frequent and higher amounts of rain supplementation. We will provide an update on the status of the project, present preliminary results from our first two cohorts of hatchlings, as well as discuss some of the challenges encountered.

Multi-state Role of Integrative Research and Conservation Training Provided by the Desert Tortoise Conservation Center

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The challenge to conserve the Mojave Desert Tortoise is confronted by extraordinary demands that signify a new era in integrative conservation. San Diego Zoo Global, in partnership with US Fish and Wildlife Service, Bureau of Land Management and Nevada Department of Wildlife, operates the Desert Tortoise Conservation Center in Las Vegas, Nevada. The center currently holds roughly 2000 tortoises, either displaced from development sites in Southern Nevada or previously owned as pets. The Center contributes to recovery of the Mojave Desert

Tortoise through collaborative research, conservation, training and education. Captive management of tortoises at DTCC prepares healthy tortoises for release back into native habitat, ensuring the fittest representatives are available for recovery. In collaboration with FWS, we provide specialized training course modules for biologists in the public and private sector carrying out mitigation efforts in all states across the range of the desert tortoise. Training modules prepare students to conduct transect surveys, handle tortoises, conduct health assessments, and collect biological samples in the manner needed to evaluate tortoises prior to a translocation. Documentation of course completion should be submitted with any permit application or authorized individual request, and ensures standardized data collection across the range.

Spatio-temporal Foraging Patterns of Mojave Desert Coyotes: Implications for Desert Tortoises

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Coyotes (*Canis latrans*) are ubiquitous opportunistic foragers that can be significant predators on Threatened desert tortoises (*Gopherus agassizii*). In recent tortoise relocation efforts in the Fort Irwin, CA region, higher than expected mortality rates were observed on translocated, resident, and control groups, based on radio telemetry. The rate on a number of sites exceeded 20%, and reached 45% on one site. It is unclear whether such rates represent the norm, and how they might be influenced by the availability of alternate foods including anthropogenic items. We initiated a 4-year investigation of coyote foraging patterns in the Fort Irwin area. Our objectives are to (1) quantify seasonal and annual use of food items by coyotes, (2) assess annual abundance of primary food items, (3) assess spatial variation in food item use and availability, and (4) collaborate with desert tortoise researchers in an effort to determine whether item use, item availability, or coyote abundance correlate with observed temporal and spatial variation in coyote predation rates on tortoises. From Fall 2009 to Summer 2011, 1101 coyote scats were collected and analyzed. Primary items occurring in scats included rabbit, kangaroo rat, pocket mouse, and snake. For the first two years of the study, item use generally was similar between the years, among the four seasons, and among the 3 portions of the study area. Anthropogenic items occurred in less than 5% of scats and included livestock, cats, dogs, and refuse. Thus, coyotes in this area do not appear to be significantly supplemented by anthropogenic items. Desert tortoise occurred in 5-6% of scats, and was most prevalent in the central portion of the study area. Abundance indices for rabbits (based on pellet counts) and small rodents (based on burrow counts) were variable among portions of the study area, and did not correspond well with occurrence of these items in scats. Data collection will continue for 2 more years and also will include indices of coyote abundance across the study site.

A New Approach to Recovery of the Mojave Desert Tortoise

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Challenges to recovering the threatened Mojave desert tortoise (*Gopherus agassizii*) include 1) incomplete understanding of threats most responsible for population declines, 2) insufficient information on effectiveness of management actions, and 3) intractability of addressing threats across a large range and multiple jurisdictions. Recognition that these challenges require long-term conservation efforts to ensure species persistence, with or without the protections of the ESA (i.e., the Mojave desert tortoise is a conservation-reliant species), necessitates a more structured approach to recovery, including broad participation of stakeholders. Our approach incorporates an interactive decision-support system to assist with threats assessments and recovery action ranking with cross-jurisdictional recovery implementation teams composed of land and wildlife managers, nongovernmental stakeholders, and scientists, to prioritize, coordinate and track the implementation of recovery actions at manageable spatial scales. We initiated the recovery implementation teams in 2012 to develop recovery action plans for each team area, the first step in implementing a more structured and tractable approach to recovery.

Improving Solar Energy Permitting for Desert Tortoise: An Environmental NGO Perspective

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Defenders of Wildlife has been working on renewable energy and conservation issues in the California desert, specifically related to desert tortoise, since 2009 when the Bureau of Land Management began processing right of way applications for solar energy projects on public land. Based on environmental review documents and biological opinions from the U.S. Fish and Wildlife Service for seven approved solar projects, Defenders estimates that, when built, these seven projects will result in the "take" of 1,317 individuals and impacts to 20,000 acres of desert tortoise habitat. Three of the six projects already permitted overlap with U.S. Fish and Wildlife Service identified priority linkage habitat. BLM continues to process applications for an additional 20 solar energy projects involving approximately 116,000 acres of public land, of which approximately 110,000 acres are within desert tortoise habitat, also supporting a wide range of population density from very low to very high. Defenders view this impact as unnecessary and a roadblock to recovery of the species. In this presentation, we discuss five ways in which the permitting process can be improved in order to avoid and minimize impacts to desert tortoise: 1) site solar energy facilities on disturbed or degraded lands; 2) avoid desert tortoise habitat and linkage areas; 3) create a process for early and ongoing input from stakeholders and developers; 4) adopt of USFWS Conservation Recommendations as terms and conditions for project development; 5) ensure mitigation is effective, strategic and coordinated.

Desert Tortoise Conservation in an Era of Information Overload

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The desert tortoise is a high profile example of conservation biology in action. Hundreds of peer-reviewed publications contribute to our knowledge of this species and research continues at a solid pace as is evidenced by this symposium. In addition, advances in technology have made the accessibility and manageability of larger and more robust datasets available to provide detailed analyses that were hardly imaginable even just a few years ago. For example, we have recently assembled the desert tortoise transcriptome using tens of millions of DNA sequences and an analysis pipeline that required 80 CPUs and 160 GB of memory on a high-throughput computing system. This massive dataset allows us to ask extremely high resolution questions about the evolutionary history of desert tortoises in the genus *Gopherus*. Technological and computing advances like this are observed across disciplines including GIS, climate change modeling, and risk assessment analysis. But has this abundance of knowledge contributed to conservation? In 2011 the US Fish and Wildlife service reported the status of *G. agassizii* as 'declining' after a 5-year review. Of greater concern is that there has been little to no reduction of identified threats to desert tortoises throughout their range. This may be because the life history traits of desert tortoise make monitoring of short-term trends extremely difficult. Or, perhaps the threats to tortoises are growing faster than our ability to act (or the tortoise's ability to compensate). How can we explain this seeming disconnect between knowledge and action? Is it possible that the plethora of information has actually hindered conservation efforts by increasing the complexity of the system? The process of science allows an infinite amount of questioning to which answers typically inspire new questions. Conservation on the other hand requires bold action, often making decisions with limited information. I fully embrace the act of discovery employed through the scientific method, but also want to ensure the effective application of scientific research to conservation efforts. How can we better apply science to conservation decision making without getting bogged down in the details? I argue that most of the information required to make effective choices about desert tortoise conservation is in our hands right now. The fundamental principles of ecology and evolution can be applied to management strategies where data are lacking. I also suggest that we need to reevaluate the ethical paradigm that we use to approach species conservation. The guiding principles we employ as conservationists need to accommodate the increasing complexity of environmental and technical information. In a world of experts it is important for the scientific community to find commonality in our objectives and to strive to reduce the complexity of the information we provide.

How Do Turtles Communicate?

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The studies of communication in turtles for many years revolved around the idea of tactile, visual, and olfactory sensations manifested in courtship and copulation events. Recently research in this area has expanded dramatically, demonstrating that turtles have a well-developed auditory capacity below 1000 Hz, both in air and in water. At the present time sound communication has been documented as an important mechanism for information exchange within a turtles as a group; at least 44 species in the families Testudinidae, Tryonichidae, Emydidae, Bataguridae, Podocnemididae, Dermochelyidae and Cheloniidae are known to emit sound signals under different contexts. Sounds have been mostly documented during courtship and and copulation, showing that vocalizations are important for reproduction in some species of turtles. At the present time the most exciting results are with freshwater turtles, where we are beginning to understand underwater sound communication. Only two species of turtles have been studied extensively, *Chelodina oblonga* in Australia and *Podocnemis expansa* in the Brazilian Amazon. These studies reveal that turtles emit low frequency sounds (36 a 4500 Hz) during all phases of their life cycle, from embryos within the egg to mature adults. These recent discoveries show that these animals are much more social than was imagined. Our studies of underwater sounds being produced by these turtles is shedding light on how they form groups during annual migrations to the nesting beaches, how hundreds of turtles simultaneously leave the water to bask, what influences group nesting behavior (arribadas), synchronization of eggs hatching and hatchlings dispersing from the nest to the water, hatchlings migrating with the females to the feeding areas, and now how mixed aged groups forage together during the feeding season in the flooded forest.

Desert Tortoise Conservation and Recovery on California BLM Lands

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In 2012, BLM continued to work on projects such as signing routes, restoring habitat, public outreach, and acquisitions of private land. However, as was true the last three years, most of our effort and time was focused on solar and wind energy projects. In 2012, we participated (and continue to do so) in the Desert Renewable Energy Conservation Plan. Two new conservation policies were approved. One is related to durability and established the requirements for conservation on public lands that would then allow those activities to meet California State statutes. The other is retirement or relinquishment of grazing as a mitigation option. We continued to collaborate with US Fish and Wildlife Service on a spatial decision support system, a tool that continues assist BLM in assessing the impacts of renewable energy development and evaluating the relative benefits of different mitigation actions for tortoise. We continue to look for ways of leveraging the effectiveness monitoring associated with renewable

energy projects into larger research projects and coordinating the data to better inform us on impacts to tortoise.

Population Augmentation of the Mojave Desert Tortoise: Using Translocation Strategically

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Translocations are frequently initiated when there is conflict between humans and animals, yet a desire to let the animals live out their lives in the wild. Alternatively, translocations can be used in proactive conservation efforts such as attempts to augment populations. For desert tortoises, much of the focus has been on translocation as the result of land use conflict, especially the last several years with expanding operations on Department of Defense lands and the installation of solar energy facilities. The third strategic element in the Mojave desert tortoise's recovery plan is to augment depleted populations through a strategic program. The program builds upon research into translocation, genetics, and disease to establish guidance and protocols for conducting translocations and uses monitoring data to help select sites to augment. We are preparing for the first large-scale, experimental releases under this program. Through these augmentation efforts, we expect to learn more about factors that threaten the persistence of populations, the effectiveness of recovery actions, and will, hopefully, have success in bolstering populations that would otherwise be slow to recover.

Release Site Habitat Affects Post-translocation Movement: A Closer Look at the Microclimate of Chosen Shelter Sites

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The Mojave desert tortoise (*Gopherus agassizii*) occupies a variety of habitats, within which soil burrows and caliche caves are used as shelter. In particular, caliche caves, which are found in higher densities within desert wash systems, are an easily mapped, long-lasting habitat feature that provides refuge from predators and thermal extremes. Tortoises that occupy flats and sloping bajadas commonly rely on more ephemeral soil burrows, both pre-existing or newly constructed. Our recent translocation studies have shown that releases made directly into wash systems can impact the post-translocation movement of desert tortoises with animals released in washes staying significantly closer to the release site than those released on flats. Though the exact cause of this is unknown, we hypothesize that it may be impacted by differences in retreat site qualities. We monitored temperature and humidity over a one year period in 26 retreat sites

used by translocated tortoises and will present an initial look at differences in environmental qualities between caliche caves and soil burrows.

Screening for Disease Agents in the Ornithodoros Tick Found on the Desert Tortoise (*Gopherus agassizii*)

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The number of ectoparasites (*Ornithodoros* sp.*)* observed on-site at the DTCC and on the desert tortoises, *Gopherus agassizii,* has increased substantially since surveillance began in 2009. Because tick species are known vectors of disease, a study was initiated to determine what pathogens, if any, the *Ornithodoros* tick species at the DTCC carry. Over 450 ticks collected between 2009 and 2011 from *Gopherus agassizii* were categorized into 40 pools based on the DTCC pen location they were found. DNA was extracted and PCR tested for eight pathogens. Pathogens tested for (*Mycoplasma agassizii, M. testudineum,* Chlamydophila, Herpesvirus, Rickettsia, Flavivirus, *Francisella tularensis,* Borrelia) included pathogens present in the DTCC population, tick-borne pathogens that occur in and out of the geographic range of the desert tortoise, and pathogens known to affect other Mojave Desert species. Four of the eight agents were positive in six of the 40 pools: *Mycoplasma agassizii*, Herpesvirus, Chlamydophila, and Rickettsia. Future research is necessary to determine if the *Ornithodoros* ticks are able to transmit these agents between desert tortoises, and thereby necessary to consider in translocation/conservation efforts.

Desert Tortoise Occupancy Monitoring on the Arizona Army National Guard's Florence Military Reservation, Pinal County, Arizona

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In 2000, the Arizona Game and Fish Department began desert tortoise monitoring on the Arizona Army National Guard's Florence Military Reservation (FMR) in Pinal County, AZ. In an effort to continue stewardship of tortoises and their habitat, a 2-year pilot study on the FMR to determine occupancy and detection probability was conducted in 2008-09. Using estimates from this study, we designed a desert tortoise occupancy monitoring program for the FMR. Our first year of monitoring occurred between July and October 2011, and included 415 occupancy surveys on 85 sites and detected 55 tortoises. In October 2012, we completed 425 desert tortoise surveys, and detected 37 desert tortoises on 21 survey plots. Desert tortoise occupancy decreased as elevation increased. We estimated desert tortoise occupancy ranged from at 0 to 0.47 across survey plots (mean occupancy was 0.31; ± 0.05 SE). Overall tortoise detection was estimated at 0.19 (± 0.04 SE).

STUDENT PAPER

Effects of a Nonnative-grass Invasion on Demography and Condition of Sonoran Desert Tortoises

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By altering ecosystem structure and function, invasions by nonnative plants have the potential to alter the quantity and quality of habitat for animals. We examined effects of buffelgrass (*Pennisetum ciliare*), a nonnative grass that is increasing markedly in distribution throughout the southwestern United States and Mexico, on Sonoran desert tortoises (*Gopherus morafkai*). In 2010 and 2011, we established 50 4-ha plots that spanned the gradient of buffelgrass cover in areas of high-quality tortoise habitat in southern Arizona on which we characterized density, population structure, and physical condition of tortoises. We detected tortoises on 45 of 50 plots (90%) and ≥1 tortoise on 114 of 200 surveys (57%). Density of tortoises did not vary with the amount of buffelgrass cover, and averaged 0.30 tortoises/ha (SE = 0.06) in areas with high buffelgrass cover and 0.36 tortoises/ha (SE = 0.06) in areas where buffelgrass was absent. Age and sex structure of the tortoise population did not vary with the amount of buffelgrass cover. Condition of adult tortoises, however, averaged 10% lower in areas where cover of buffelgrass was relatively high (15-25%) relative to areas where buffelgrass was absent or cover was low (<1%). Although density of tortoises did not vary with existing levels of buffelgrass cover, the reduction in condition of tortoises in invaded areas could manifest as population-level effects over longer time periods, especially if buffelgrass continues to expand in density and distribution as predicted.

Dog Predation and Vehicular Trauma in Gopher Tortoises (*Gopherus polyphemus*) Admitted to the University of Florida

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The medical records of 227 gopher tortoises (*Gopherus polyphemus*) presented to the Small Animal Hospital, University of Florida, between 1998 and 2006 were reviewed. Dog predation (43%) and vehicular trauma (32%) were the primary causes for presentation. Most were admitted between spring and fall corresponding to increased activity. Of the 170 cases admitted for predation and vehicular collision, 36% were euthanatized, 7% died spontaneously, 39% were released to rehabilitation facilities, 9% were released to the wild, 6% had an unknown disposition, and 3% were released back to the person who found them. Although this study was performed in 2007, dog predation remains the main reason for evaluation of gopher tortoises at the Small Animal Hospital. This predation is an important cause of morbidity and mortality in adult gopher tortoises in north-central Florida and probably other urbanizing environments within their range.

Discriminating the Health of Confiscated and Wild Tortoises in Southern Africa: Univariate and Multivariate Analyses of Body Condition and Haematology

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Health assessments serve many purposes and we used reference values to evaluate whether the health of tortoises confiscated from poachers was compromised compared to that of their wild counterparts. Confiscate body condition, as indicated in $\log_{10}$ body mass regressions on $\log_{10}$ carapace length (analyses of covariance), was low compared to that of wild tortoises. However, for one species, *Chersina angulata*, confiscate hematocrit and hemoglobin values were also lower than reference values. These quick health assessments helped convict the poachers, and were possible because reference values were available for the appropriate species, sexes and season. Discriminant analyses were very strong, often using both body condition and hematology variables to classify confiscate tortoises successfully. Factor analyses suggested there were two main variates, body size and hematology, but there were species differences in the importance of these two variates and the four variables $\log_{10}$ body mass, $\log_{10}$ carapace length, hematocrit and hemoglobin concentration. The multivariate analyses improved the conservation and scientific value of this study, and with the discriminant functions, should improve future studies.

Clark County Multiple Species Habitat Conservation Plan Update

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The Clark County Desert Conservation Program (DCP) continues to administer the Multiple Species Habitat Conservation Plan (MSHCP) on behalf of the Cities, Clark County and Nevada Department of Transportation as mitigation for an Endangered Species Act section 10 incidental take permit for desert tortoise and 77 other species of plants and animals. The DCP has collected mitigation fees for more than 451 acres of take during the period of January to September 2012, leaving 66,077 acres on the permit. The 2013-2015 Implementation Plan and Budget was approved for $8,404,941. Highlights of the past year include mobilization of a desert tortoise occupancy monitoring pilot project, implementation of road monitoring to improve law enforcement, and initiation of Phase I restoration sites in the Boulder City Conservation Easement.

QuadState Local Governments Authority: Counties participate in Desert Tortoise Recovery Planning and Other Natural Resources Activities

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QuadState LGA is entering its fourteenth year of operation. We represent 10 local governments in the Mojave and Sonoran Deserts on a variety of natural resources issues.

Our primary organizational interest remains desert tortoise. Counties have been engaged with the Recovery Implementation Teams and will continue to see that process through. We have membership on the Management Oversight Group, and look forward to that re-constituted organization finally meeting in 2013.

Counties are engaged with the California Desert Managers Group, We participate in the Mojave Desert Initiative which covers the three "eastern" states of the Mojave. We also look forward to serving with the Arizona Interagency Desert Tortoise Team, representing of our Arizona member counties.

QuadState grew from a need by the counties for services and advice regarding desert tortoise, and other public lands issues for which many lack staffing to cover. The number of organizations and meetings needing coverage has grown.

During the past year we have become part of the Western Regional Partnership, an interagency group organized by Department of Defense. It is very much engaged in communication and coordination of information on natural resources and energy issues.

We have also sat with the Desert Landscape Conservation Cooperative. This regional organization is setting out formal statements of research and science needs and priorities. While nationally operated under the Fish and Wildlife Service, the Desert LCC is managed by the US Bureau of Reclamation. I will leave it to their leadership to discuss and explain this initiative with you.

Shy versus Bold: Can Desert Tortoise Personalities Predict Movement Patterns During Translocation Events?

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Behavioral syndromes, or animal personalities, are an emerging area of research in behavioral ecology. Behavioral syndromes aim to classify animals on related personality axes, including boldness, curiosity, aggressiveness, or sociability. They aim to identify sets of associated behaviors across time and within different contexts, and personality studies have been conducted on diverse taxa, spanning fishes to mammals. Such syndromes have been linked to

various life history characteristics; for example recent research of behavioral syndromes in Namibian rock agamas (*Agama planiceps*) found bold individuals had larger home ranges and fed more, but also had a higher amount of tail loss, suggesting increased predation.

Here we present preliminary research of behavioral syndromes in desert tortoises (*Gopherus agassizii*). We tested 60 captive juvenile tortoises and 100 wild adult tortoises in Fall 2012 for curiosity and boldness in 7 different tests. We found personality type (e.g. shy vs. bold) was a significant predictor of movement patterns and home range size, and discuss how this data may be helpful during future translocation efforts.

Recovery Progress at Mojave National Preserve

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Restoration of cattle-trampled areas (piospheres) in Mojave National Preserve desert tortoise habitat was initiated in 2012 with the seeding of native tortoise forage plants on 10 acres of disturbed land. These acres will be irrigated through the winter in the absence of rain. While surveying 508 miles of powerlines for raven nests and evidence of predation by ravens on juvenile tortoise, park staff encountered 11 active raven nests, 35 active red tailed hawk nests, one active long-eared owl nest, two active nests of unknown species, and 44 inactive nests. No new juvenile tortoise mortalities related to raven predation were observed associated with these nests. Twelve small game guzzlers were inspected and cleaned in 2012. No new tortoise mortalities were observed since the last inspection in 2004. Road mortalities continue to be a problem, with four road-related mortalities observed in 2012. The lower number than usual may reflect a very dry spring and summer. Environmental protection was extended to 3234 acres of tortoise habitat and potential habitat by the acquisition of 51 parcels donated to the Preserve. Old junk and some hazardous materials were cleaned up at 11 parcels with a total of 8.5 tons of solid waste removed from tortoise habitat. Weed control was accomplished primarily by drought this year but hand-pulling of Russian thistle was completed on 128 acres. Efforts continued for transferring the tortoise research facility in Ivanpah to the National Park Service. Concurrence was obtained from the Fish and Wildlife Service that the facility and land constituted acceptable compensation for activities related to the Molycorp wastewater pipeline. Progress is being made towards official acceptance sometime in late spring or early summer 2013. A strong team of researchers from Savannah River Ecology Lab and University of California, Davis, began work at the facility in 2011.

It's Not Easy Being Green

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What is driving the current Green Gold Rush in the Southwestern deserts, and what have we really achieved? We had Arnold Schwarzenegger seeing the desert as a "*gold mine*", and

then Jerry Brown vowing to "*crush*" any opposition for renewable energy. Federal, state, and local governments have spent billions of our taxpayer dollars subsidizing technology research and renewable energy projects. ***Solyndra***, ***Abound Solar***, and ***Beacon Power***, have already failed, resulting in enormous losses of taxpayer dollars and an ongoing investigation by the House of Representatives. Despite the significant losses, they are only a tiny fraction of the amount of taxpayer dollars still in play.

An economic view of what continues to drive the *Green Gold Rush* will be presented. While the conservation impacts of renewable energy cannot be overstated, they will not be addressed by this study. Instead, an economic look is taken at the major drivers and factors affecting the development and future success of renewable energy. These drivers include basic supply and demand, with a little *help* from the U.S. government and us taxpayers.

The year 2012 brought us the hottest year on record, beating the previous record by one degree Fahrenheit. Additionally, anomalous events such as Hurricane Sandy and the drought in the Southwestern United States, provide further reinforcement that the world's addiction to fossil fuels needs to be addressed. For California, millions of taxpayer and ratepayer dollars and tens of thousands of acres of public lands have been invested into renewable energy projects. The result – energy demand will be met with an increased amount of renewable energy, and ratepayers costs are expected to increase as the wholesale price of renewable energy is still double the price of existing wholesale prices. We may very well be reaching the tipping point in this renewable energy revolution.

Bilateral Symblepharon and *Mycoplasma testudineum* Infection in a Wild Desert Tortoise

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An immature desert tortoise (*Gopherus agassizii*) from the Desert Tortoise Natural Area Interpretive Center plot (Site 4) in Kern County, California, was submitted to the College of Veterinary Medicine, University of Florida (UF) due to bilateral lesions of the dorsal half of the cornea. The palpebrae also appeared to be abnormal. Following arrival the tortoise was given an ophthalmological examination and cytological preparations revealed a mild heterophilic keratitis with bacterial infection, epithelial hyperplasia, and the presence of a moderate number of extracellular diplococci and bipolar rods. The eye lesions were diagnosed as bilateral symblepharon, which is a partial or complete adhesion of the palpebral conjunctiva of the eyelid to the bulbar conjunctiva of the eyeball. In humans and domestic animals this can be due to: 1) autoimmune disease; 2) hypersensitivity to environmental allergens; 3) drug induced toxic

epidermal necrosis; 4) burns; and 5) various infectious agents. After arrival at UF the tortoise developed a nasal discharge. Subsequently a blood sample was obtained for *Mycoplasma* serology and the tortoise was euthanatized and necropsied. The lesions on the globes were hyperplastic epithelial cells originating from the palpebral conjunctiva. Epithelial cells were dysplastic (abnormal arrangement) and vacuolated cells were seen with eosinophilic intracytoplasmic inclusions. There was moderate to severe hyperplasia of epithelial cells in lacrymal glands along with moderate to severe inflammatory infiltrates. Similar hyperplastic cells with inclusions were seen in the submandibular salivary glands, tongue, and glottis. There were multifocal areas of epithelial hyperplasia in the nasal cavity and *Mycoplasma testudineum* was identified in both nasal cavities using DNA fingerprinting. The ELISA titer was suspect for exposure to *M. agassizii* and positive for exposure *to M. testudineum*. Using PCR, samples and swabs of the eye lesion were tested for herpesvirus, C*hlamydophila*, *Mycoplasma*, and *Mycobacterium*; all tests were negative. Electron microscopy is being used to identify the nature of the inclusions.

Desert Managers Group: Desert Tortoise Information and Youth Education

Rebecca Jones, California Dept. of Fish and Wildlife; Fon Duke, Dept. of Defense Coordinator; and Russell Scofield, Dept. of Interior Coordinator
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Desert Managers Group, Barstow, California

The Desert Managers Group (DMG), an organization of federal, state, and county land managing agencies in the California deserts, focuses on coordinating and integrating desert tortoise recovery actions and monitoring efforts among managers and scientists across jurisdictional boundaries. A key to desert tortoise recovery is an informed public that understands and appreciates desert tortoise recovery. Since 2004, DMG has partnered with non-governmental organizations to implement its Desert Tortoise Information and Youth Education Program (Program). Some goals of the Program include standards based environmental education, brochures targeting specific audiences or topics, personal contacts at events, the Mojave Maxine Contest and media releases. The Program has been funded wholly by grants and recently, those grants have become increasingly difficult to obtain, especially for the program coordinators salary which resulting in having to lay off the coordinator. Absent a coordination, the Program will continue, whoever with a much reduced scope.

U.S. Geological Survey Update

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USGS scientists have worked hard to address important information needs relevant to the desert tortoise. Lesley DeFalco continues to monitor the outcome of restoration efforts at multiple sites across southern Nevada and northwestern Arizona. This monitoring project began after 2005/6 wildfires. She is refining seeding methods, herbicide use, and outplanting methods

based on what she has learned. In an effort to more effectively share scientific information with land managers and the public, Matt Brooks is heavily involved in preparing the first Southern Nevada Agency Partnership report. This report pulls together the latest scientific information on a wide range of desert land management topics. Ken Nussear ,Todd Esque and Lesley DeFalco have recently analyzed the desert tortoise's use of burned habitat in the eastern Mojave Desert. This work is funded in part by USFWS, BLM, and the NV Department of Wildlife. They have also identified areas of high genetic diversity and divergence among 15 vertebrate species in the Mojave Desert. This information can be used to guide conservation efforts. Kristin Berry has recently determined that desert tortoises kept as pets should not be reintroduced into wild populations because of disease and genetic mixing concerns. Kristin's long-term data sets are being digitized and formatted for ease of in-depth analysis. Kristin also revisited a low-density population on China Lake in the northern Mojave after 37 years to compare population characteristics. Predators continue to limit recruitment of immature tortoises into the adult population. The close proximity of expanding towns and cities subsidize predators.

Measuring and Understanding Relationships of Desert Eagles to the Environment and to Renewable Energy Development: Context and Preliminary Interpretation

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Renewable energy is quickly changing desert landscapes and impacting biodiversity region-wide. Understanding the impacts of energy development on wildlife is essential to developing effective strategies and recommendations for siting projects and to minimize impacts to individual animals and populations. This is especially important in areas of high biodiversity, such as the Mojave Desert.

Golden eagles are an emblematic species that are indicative of areas of high biodiversity and highly sensitive to human disturbance. In California, they are listed as a species of concern by numerous state and federal agencies. Development of renewable energy is a rapidly emerging and important concern that has the potential to impact eagles at all stages of their life history. This is especially important because there is a known history of golden eagle conflict with California wind energy plants, primarily through direct mortality from collisions. More recently, growth of the solar energy industry presents additional indirect risk to birds, primarily through habitat conversion and loss.

The goal of our research is to understand how golden eagles use their environment and how this use may expose or protect eagles from risk from renewable energy development. We do this through use of high-frequency GPS-GSM telemetry systems to track and characterize eagle movements and behavior. We seek to understand the drivers and implications of variation in ranging behavior, to identify habitats that are important to eagles, to characterize eagle demography, and to understand eagle movements in relation to climate, weather and topography.

This talk will be divided into two parts. First, to show the approach we will take in California, I will discuss similar work we have conducted in eastern North America on migratory golden eagles. Second, having established the context for the work in California, I will then lay out the framework for that project and provide preliminary results on seasonal eagle movement.

In eastern North America we have monitored movement of ~50 golden eagles over a ~7-year period with GPS-GSM and satellite GPS telemetry systems to evaluate potential risk to eagles and other raptors from wind turbines along migratory routes. To understand risk birds face, we evaluated the response of eagle flight altitude to changes in topography over which they were flying. Eagles flew at relatively lower altitude over steep slopes and cliffs than over flats and gentle slopes. Also, birds engaged in local movements turned more frequently and flew at lower altitude than they did when in active migration. We also evaluated migratory movements in the context of weather data (NOAA, NCEP, NARR). Here, we show that the meteorological conditions during migration (e.g., wind speed, wind direction, and ground heat flux) differ between spring and fall. During spring, migration occurred at low to moderate wind speeds, southwest winds, and negative ground heat flux (atmospheric heating). During fall, migratory flights were associated with moderate to high speed winds from the west and positive ground heat flux. These flight behaviors help us understand eagles flight responses and thus, the extent to which eagles may be at risk from wind turbines when on migration.

In the Mojave Desert near Barstow, we are evaluating movement of 7 non-migratory territorial adult eagles. Preliminary analyses show that when eagles had eggs or chicks in the nest, both males and females maintained and defended a relatively small home range and only rarely moved more than 2-3 km from their nest. Once breeding was completed (characterized by either reproductive failure or fledging of chicks), eagle behavior changed and birds were much more likely to make longer distance movements (16-30km, on average) to high elevation areas. On longer distance flights, flight altitudes were higher suggesting that risk from wind energy is higher during short-distance movements associated with breeding.

Our research identifies how topography and weather interact with eagle behavior to drive potential human-wildlife conflict that results from renewable energy development. With global climate change, weather patterns are expected to change. This may have dramatic effects on movements and fecundity of desert dwelling eagles. At potential wind energy development sites, risk assessment for volant species needs to incorporate understanding of climate, weather, and topography and their relationship to the varied types of movement of wildlife that increase risk of negative interactions. Finally, as our data show, desert eagles use a much larger area than has been previously recognized and development in the high-country that eagles visit post-breeding may pose a greater risk to those birds than was previously thought. This is particularly important because desert eagles may have relatively lower fecundity than other populations and thus face relatively greater demographic risks.

Landfill Decision Looms Over Conservation Legacy for Tortoises

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Recently released models by the National Park Service indicate that the eventual Bureau of Land Management permitting of the Eagle Mountain Landfill could cause significant harm to desert tortoise recovery efforts and to robust populations throughout and adjacent to Joshua Tree National Park. The National Parks Conservation Association (NPCA) has legally opposed this project for nearly 30 years, and won a real victory as the appealed case was decided against being heard by the Supreme Court. Despite this victory, the project's proponent has declared bankruptcy and the property is currently being shopped to prospective buyers who intend to move forward with the landfill concept. This region is currently site to two large-scale solar projects, and is within close proximity to the largest solar energy zone in the country, the Riverside East SEZ. This presentation will give a brief history of the project, highlight the newly released data on proposed impacts, and discuss both the need for this project and the actions that can be taken to protect tortoises in this region.

Demography of Desert Tortoise Biologists

Dr. Larry LaPre, Wildlife Biologist
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Construction of renewable energy projects and transmission lines in the California Desert has resulted in a hiring boom for biologists who survey, monitor and protect the desert tortoise. More than 400 biologists have been reviewed and approved to conduct this work. Based on qualifications submitted to the BLM, the sex ratio is nearly even between men and women. The majority of workers fall into the age class of 25-35 years old, though the range is from 24 to 65. Educational background is primarily bachelor's degrees in biology, zoology or environmental science, but many biologists with master's degrees perform the more advanced tasks, such as transmitter work and health assessments. Several PhD level biologists and a few MDs and DVMs were employed. The biologists came from more than 30 states, and at least 4 other countries. California had the majority, followed by Arizona and Alaska. Locations with high numbers of desert tortoise biologists included Haines, Alaska, Flagstaff and Tucson, Arizona and Moab, Utah.

Detectability of Agassiz's Desert Tortoise in the Morongo Basin, San Bernardino County, California

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Between 1990 and 2012 biologists using presence-absence survey protocols established by the U.S. Fish and Wildlife Service for detection of Agassiz's desert tortoise performed a total of 251 focused surveys on 203 sites in an urbanizing portion of the West Mojave Desert known as the "Morongo Basin," which extends from Yucca Valley to the west to Twentynine Palms to the east in San Bernardino County, California.

A total of approximately 11,545 acres and 67.5 linear miles of pipeline and road right-of-ways were surveyed. Of the 251 surveys, 115 were performed on 5,104 acres in and adjacent to the Town of Yucca Valley, 75 on 2,885 acres in the unincorporated community of Joshua Tree, and 59 were performed on 3,556 acres in and adjacent to the City of Twentynine Palms. Of the 115 surveys performed in Yucca Valley, tortoise sign was detected on 38 (33%) of them; of 75 surveys in Joshua Tree, tortoise sign was detected on 53 (71%); and, of 59 surveys in Twentynine Palms, tortoise sign was detected on 21 (36%). The spatial distributions of sites with and without tortoise signs are plotted on aerial photographs that clearly show the absence of tortoise sign in urbanizing portions of all three communities, and particularly, Yucca Valley and Twentynine Palms

Cumulatively, of the 11,545 acres surveyed, tortoise sign was found onsite or in adjacent areas on 8,754 acres, or approximately 76% of the acreage surveyed. Of the 5,104 acres surveyed in Yucca Valley, tortoise sign was found on 3,470 acres (68%), compared to 73% (2,606 of 3,556 acres) surveyed in Twentynine Palms and 93% (2,678 of 2,885 acres) surveyed in Joshua Tree. Therefore, although tortoise sign was found on only 45% of the surveys performed (112 of 251 surveys), tortoise sign was found on 76% of the acreage surveyed.

Cumulatively, surveyors found 3,693 tortoise scat, 548 burrows, 161 carcasses, and 84 tortoises. As such the ratio of detections among these four sign types was 44 scat : 6.5 burrows : 2 carcasses : 1 tortoise. These observations emphasize the importance of seeking tortoise scat during presence-absence surveys, as they are about 44 times more prevalent (or detectable) than tortoises.

Of the 251 surveys, 239 were performed year-round, prior to the 2010 U.S. Fish and Wildlife Service survey protocol that restricts surveys to the periods of April-May and September-October. Tortoise sign has been detected throughout the year. The following table compares months in which all 251 surveys were performed to months in which living tortoise sign (i.e., excluding sites with only carcasses) was found during 109 surveys:

Surveys	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
# of 251	16	28	19	25	19	17	14	17	24	32	23	17
% of 251	6.4	11.1	7.6	9.9	7.6	6.8	5.6	6.8	9.6	12.7	9.2	6.8
# of 109	3	13	11	7	11	6	5	6	15	20	9	3
% of 109	2.7	11.9	10.1	6.4	10.1	5.5	4.6	5.5	13.8	18.3	8.2	2.7

These comparisons suggest that tortoises may be somewhat less detectable in January and December and somewhat more detectable in September and October relative to the level of survey effort, and that there is no time during the year when tortoise sign is not detectable.

The final comparison is the relative number of the 109 surveys where tortoise sign was found compared to the relative number of 84 tortoises observed during those same months:

Surveys	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
# of 109	3	13	11	7	11	6	5	6	15	20	9	3
% of 109	2.7	11.9	10.1	6.4	10.1	5.5	4.6	5.5	13.8	18.3	8.2	2.7
# 84 DTs	1	4	6	7	5	1	2	8	41	4	4	1
% of 84	1.2	4.8	7.1	8.3	5.9	1.2	2.4	9.5	48.9	4.8	4.8	1.2

The most striking comparison here is the detection of almost 50% of the tortoises during the month of September when only about 14% of the survey effort was expended. Otherwise, these data demonstrate that tortoises are detectable year round.

Partnerships for Protection at the Desert Tortoise Research Natural Area

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In light of the diverse and cumulative impacts to desert tortoise populations and desert-wide planning efforts for renewable energy development, collaborative conservation efforts are crucial for desert tortoise recovery. For nearly 40 years, the Desert Tortoise Research Natural Area (DTRNA) has been an example of collaboration among state, federal, and local agencies, non-governmental organizations, and dedicated individuals. Established to protect habitat supporting some of the highest known tortoise densities at that time, the DTRNA boasts a high level of protection with scientifically illustrated benefits for native plant and animal communities. It is also an important site for educational outreach, scientific research, and adaptive management. The Desert Tortoise Preserve Committee, Inc. (DTPC) helped establish the DTRNA and has worked with state and federal agencies since 1974 to protect and enhance habitat in and around this site. Progress over the past year includes the acquisition of over 290

acres of additional habitat in the DTRNA and adjacent expansion areas, installation of signs and camouflage treatment of vehicle routes in unfenced conservation lands, research of Mohave ground squirrel occupancy, and a study of seed bank composition in a restoration area. The DTPC also reached over 2000 individuals with outreach presentations and events, and helped staff interpretive naturalists at the DTRNA for the 24th consecutive year. In the coming year, the DTPC must strengthen and expand its partnerships to address major management concerns, including human-subsidized predators, off-road vehicle impacts to unfenced conservation lands, and renewable energy development. In this presentation, we discuss the background of the DTRNA, the progress of the DTPC and its partners in 2012, and the management challenges ahead.

Transmission of Mycoplasmal URTD in *Gopherus agassizii*

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Mycoplasma agassizii can cause disease in wild populations of desert tortoises *(Gopherus agassizii).* In Clark County in Nevada, more than 3,230 desert tortoises were euthanized over the course of 17 years to reduce transmission of upper respiratory tract disease (URTD) among tortoises in wild populations. Immunological tools have been developed to diagnose an immune response to the pathogen, but there remains a paucity of information as to what is involved in transmitting the disease, and how the immune response in the host predicts transmissibility. Reported here are the results of a three-year study, in which serological tests and clinical signs were used to assess transmission of *M. agassizii* among desert tortoises held in semi-natural conditions in large pens at the Desert Tortoise Conservation Center in Clark County, Nevada. This study is the first large-scale, longitudinal investigation of transmission of pathogen in this host/pathogen complex. We found that the appearance of disease does not require exposure to ill tortoises, but that tortoises exposed to seropositive tortoises had a higher probability of developing clinical signs. For most tortoises, there is a lag period of eighteen months between clinical signs and seroconversion, and the appearance of clinical signs does not significantly predict seroconversion. When tortoises emerge from brumation into cool thermal environments of spring, they appear to be immunologically challenged, and significantly develop clinical signs, but many of those tortoises "recover" so that a smaller percentage of individuals show signs in the hotter months of summer and fall. The contemporary model of Mycoplasmal URTD is one of epizootic responses to a novel *Mycoplasma* escaping from pet turtles. Our research indicates that a more parsimonious model of this host-pathogen system is that *Mycoplasma* is naturally present in some wild tortoises, but that the *Mycoplasma* causes few infections unless tortoises are challenged with stress (including brumation, and cool springs).

What is the Role of Head-starting in the Mojave Desert Tortoise Recovery Program?

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Head-starting is the raising of young in captivity before translocation to the wild, thereby allowing them to reach sizes at which they are less vulnerable to certain threats. It is one of two population augmentation approaches considered in the revised recovery plan for the Mojave Desert Tortoise (*Gopherus agassizii*); the other approach involves translocation of adult tortoises to pre-selected sites. Here, we examine the practicalities and limitations of head-starting as a recovery approach for the desert tortoise. We conclude that while head-starting is a valuable tool for juvenile-focused research, its value toward directly increasing desert tortoise population sizes is hampered by being a management-intensive, expensive, and long-term approach that provides only small-scale population gains. As a result, head-starting is of limited utility as a population-augmentation tool.

STUDENT PAPER

Differential Habitat Use by Female Desert Tortoises (*Gopherus agassizii*) in Relation to Forage Availability

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Greater net energy intake should result in faster growth rates and greater reproductive output. However, resource acquisition incurs cost; activity patterns or habitat use by individuals may vary as a result. Our goal was to determine if trade-offs exist between resource acquisition and risk avoidance in Agassiz's desert tortoise (*Gopherus agassizii*). Our objectives were to determine if: 1) if resident female tortoises in two habitat types (creosote scrub and *Yucca* woodland) different in habitat structure and resource availability exhibited differences in sizes and condition; and 2) female tortoises in the two habitats varied in habitat selection. *Yucca* woodland contained more perennial shrubs with greater diversity and greater annual species diversity, abundance, and areal cover. Both shell volume and mass of *Yucca* woodland females were significantly larger but we found no difference in body condition index. During 15 – 30 August 2012 we measured vegetation surrounding used burrows and randomly selected paired locations. Creosote scrub females used burrows selectively with preference for increased annual areal cover and low grass-to-forb compositions. Burrows were placed under significantly larger shrubs; otherwise perennial characteristics were not selected. In contrast, *Yucca* woodland females did *not* select burrow sites based on annuals but instead for increased perennial shrub

number and diversity. Tortoises in areas with high forage availability may reduce selection for forage in favor of habitat that provides more cover from predators and high temperatures. In contrast, low forage availability may result in females selecting areas with greater annual plant biomass despite possible risks of exposure. By selective use of high forage areas females may maintain themselves in similar condition to females in better habitat. We propose that tortoises may alter their habitat use according to local resource availability. We further suggest that at our study site, *Yucca* woodland provides better quality habitat than creosote scrub.

Activities of the Desert Tortoise Council's Board of Directors in 2012

Daniel C. Pearson
Senior Chairperson of the Board of Directors

The Board of Directors for the Desert Tortoise Council has had another busy year. In addition to the normal task of putting on the annual Desert Tortoise Council Symposium, the Board has also been busy with putting on the Handling Workshop(s), increasing the number of workshops and the number of individuals receiving training. The Board has also worked on improving our web site, making it more useful by Council members and the public, reviewed and provided comments on numerous projects located or proposed in desert tortoise habitat, and participated in Regional Recovery Implementation Teams. We lost one Board member who resigned to pursue other related interests, and gained two new members. An elaboration the information above is provided, along with proposed activities for 2013 and beyond.

POSTER

Effects of a Pre-emergent Herbicide on Soil Inorganic Nitrogen and Native vs. Exotic Plant Production in Burned Tortoise Habitat

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In a pilot study on burned desert tortoise habitat restoration, we evaluated the use of the pre- emergent herbicide Plateau® (imazapic) on inorganic nitrogen availability and its relation to the abundance of native and exotic annual plant species during reestablishment. In the three months following herbicide application we found: 1) Plateau® treated plots showed a decreased abundance of exotic annuals and an increased availability of nitrogen, predominantly in the form of nitrate, 2) Plateau® application increased the abundance of the native annual grass *Vulpia octoflora* and shifted the composition of the annual species community during the spring, and 3) nitrogen availability increased between the colder months of January through March and declined slightly in April corresponding to accelerated annual plant growth. Pre-emergent herbicide application is an effective short-term means of front line control for disturbed areas in the Mojave Desert. On-going studies are evaluating herbicide in combination with broadcast seeding to decrease the time frame for the reestablishment of native plant communities.

A Comprehensive Disease Risk Analysis for Mojave desert tortoise (*Gopherus agassizii*) Translocations

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Translocations prompted by both ongoing development of tortoise habitat for solar energy projects and the desire to conduct targeted population augmentations necessitate knowledge-based and efficient protocols to move tortoises to new sites. In the past, disease risk mitigation efforts for translocations focused primarily on mycoplasmosis, but new data on disease prevalence and emerging disease threats call for a more comprehensive risk analysis.

Disease risk analysis is a structured process for evaluating the likelihood and consequences of specific disease hazards occurring in a population as a result of a management decision or changing circumstance. The principles behind a disease risk analysis are adapted from general risk analysis procedures used in a variety of fields, ranging from manufacturing to the military. The process typically involves six steps: problem description, hazard identification, risk assessment, risk management, implementation and review, and risk communication.

We convened an ad hoc working group composed of specialists in relevant scientific disciplines to conduct a formal risk analysis for all disease agents that could plausibly threaten the sustainability of wild desert tortoise populations if introduced or spread through translocations. The working group assessed the risks associated with each agent (or class of agent) by assigning a qualitative probability assessment (very low, low, medium, high, very high, or variable) for each of the following steps involved in the introduction and establishment of a pathogen in a population: probability the agent is present in the source population; probability the agent is absent from the destination population; probability that translocation will be the only source of exposure; probability of release and spread; probability of establishment; and probability of negative population consequence. Fifteen agents or classes of agents were evaluated and a comprehensive risk mitigation strategy was developed.

The value of a formal disease risk analysis for desert tortoises is that the structured process enables all identifiable hazards to be evaluated systematically and objectively by a multidisciplinary group. The ability to evaluate all hazards in a population context, and to weigh the risk of inaction as well as action, facilitates sound conservation management decision-making.

Comparing Long-term vs. Short-term Analysis of Spatial Data for *Gopherus morafkai*

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Long-term studies are difficult to initiate and maintain due to the large personnel and financial requirements, but are essential as they answer questions that short-term studies cannot. Most, if not all long-term studies on chelonians focus primarily on variance of demographic traits over time, with few to no studies looking at spatial aspects of turtle ecology. We are investigating spatial extent of habitat use, a critically important management issue, for *Gopherus morafkai* in central Arizona. We tracked 18 tortoises for 8 years at Sugarloaf Mountain, Maricopa County, Arizona. Monte Carlo simulations of tortoise movements demonstrated high site fidelity to a particular area. We calculated 100% and 50% minimum convex polygons (MCP) for each tortoise on a sequential annual basis (y1, y1+y2, y1+y2+y3, …). Sequential home range estimates for the 100% MCPs increased with the inclusion of each additional year. Sequential home range estimates for the 50% MCPs showed a slight decrease in size over time. The stabilization of the 50% MCP home ranges can be explained by the subsequent weighting of the arithmetic center of an individual tortoise's home range by repeated use of select shelter sites. Fifty-three percent of all male locations and 36% of all female locations were associated with one particular burrow. Year-to-year growth of 100% MCPs resulted from the addition of 1-2 outlying points. These outlying points appear to be infrequent foraging locations and/or mate-searching and courtship activities. Consequently, short-term studies, even as long as 8 years, of this long-lived reptile may not capture the full extent of habitat space requirements required for the species' life history. This is especially true given the paucity of information on ecology of juvenile *G. morafkai*, including questions about how habitat and space use change with sexual maturity.

Outreach and Fire Management in the Red Cliffs Desert Reserve

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The Red Cliffs Desert Reserve established in 1996, in Washington County, Utah , has made significant contributions in protecting tortoises and other sensitive species. This collaborative partnership is a viable and important bridge between protection and development interests. Wildfire continues to be one of the largest threats the tortoise faces in our area. Establishing fuel breaks is one of the tools we have implemented to reduce the impacts of fire. In this report we will review the cost and benefits of two distinct methods we used for creating fuel breaks. In addition to fire management issues, we will also review the current status of tortoises in the Reserve and our outreach efforts aimed at their recovery.

An Overview of the Second Independent Science Review of the California Desert Renewable Energy Conservation Plan conducted in 2012.

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A panel of 15 independent science advisors herein referred to as the Independent Science Panel, (ISP) reviewed draft documents prepared for the California Desert Renewable Energy Conservation Plan (DRECP or Plan). This was the second formal convening of an independent science advisory panel for the DRECP. A previous panel of independent science advisors (ISA) was convened in 2010 as the DRECP was beginning its work. The 2012 review occurs as the DRECP process is still ongoing, but drawing close to conclusion. The Scope of the review was "…to evaluate whether the plan has considered the best available scientific information, has been prepared using the initial ISA 2010 recommendations to the extent practicable and appropriate, and has planned for climate change effects to extent practicable." The ISP review was confined to draft consultant work products including draft biological descriptions, species models, a climate change appendix, a draft reserve design and associated maps and other supporting documents. ISP 2012 identified nine major topic areas where improvements should be made. These topic areas included, scientific expertise, the covered species list, the species distribution models, the natural communities designations, mapping and land classification as well as important gradients, climate change, reserve design modeling, adaptive management, and technical editing. As requested in the charge to the ISP the panel also assessed how well the documents made available for review incorporated the previous application of science advice from ISA 2010. Regarding the recommendations of ISA 2010 we found some recommendations were embraced, but too many appear not to have been addressed. Recommendations that appear not to have been sufficiently implemented included seeking continual scientific input and review of data, models, maps and other analytical tools and products; making all analyses and decisions as transparent and understandable as possible; matching the scale and resolution of each analytical task to the scale and resolution of the issues being addressed; subdividing the planning area into ecologically relevant units as appropriate for various tasks; developing an adaptive management framework early in DRECP development rather than near the end of the process; and beginning monitoring studies and implementing adaptive management actions immediately to reduce uncertainties and inform DRECP decisions. The Renewable Energy Action Team, in response to the science review has taken the input seriously and is working to address the comments of the panel. The REAT agencies in their response to the review agreed that much work remained to provide the clear documentation needed. The REAT Agencies also stated in their reply that they are also evaluating to what extent adjustments being made in response to the science review may affect the overall renewable energy development and biological conservation context that has been developed to date, and are working to incorporate the appropriate information.

POSTER

Data Comparison of Captive Desert Tortoises Surrendered to the Desert Tortoise Conservation Center in 2010, 2011 and 2012

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In 2009, San Diego Zoo Global took over operations of the Desert Tortoise Conservation Center (DTCC) in partnership with U.S. Fish and Wildlife Service, Bureau of Land Management and Nevada Department of Wildlife. The DTCC assumed responsibility of the Pet Desert Hotline and Pickup Service in 2010. To better understand the scope of the pet desert tortoise issues facing southern Nevada, data has been compiled over the last three years to reflect the trends found within the captive desert tortoise population. Data was collected through phone conversations and at pickup locations, and entered into a database. Data collected includes: reason for call, pickup location, reason for surrender, how tortoise was acquired, how tortoise was cared for in captivity, age and sex. The data will also compare over the last three years, pet tortoises surrendered by their custodians vs. strays found wandering in residential and commercial areas.

Creating a Raven No-fly Zone

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Common Raven predation on desert tortoises is a well-recognized threat to the long-term survival of the species in the Mojave Desert. Current responses include rearing juvenile tortoises in small, high density, headstarting pens and very limited, highly selective killing of ravens proven to be tortoise predators. There are problems associated with both of these approaches to a significant ecological imbalance associated with human subsidization of ravens.

Preliminary testing of the repulsive effects of a high intensity, visible light green laser on common ravens indicates that the devices may be successful in creating zones that ravens will choose to avoid. The range of the lasers may allow the creation of relatively very large pens with laser light substituting for the mesh roofs of traditional pens. Such large pens, several hundred meters in diameter, may serve as start-to-finish headstart pens for eggs hatched within them and also as half-way houses for naïve, pen-reared tortoises as they adjust to life in more natural circumstances. Pens of such large size may be free of problems associated with overcrowding by, and confinement of, juveniles in small areas, especially as regards their development of behavior patterns necessary for long-term survival and reproductive success after release.

The authors will describe the development of the laser, its characteristics and preliminary designs for its use in creating raven no-fly zones. A short video presentation will show its effects on ravens in limited testing in Spring 2012. They will also describe their ideas for the next phase of testing.

POSTER

Effects of Fire on Desert Tortoise Thermal Biology

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Recently, wildfires have burned extensive portions of desert tortoise habitat in the Mojave Desert resulting in changes in perennial and annual plant cover. Reduction in perennial plant cover in burned landscapes may challenge the opportunities for tortoises to thermoregulate because tortoises rely on the thermal heterogeneity provided by vegetative cover when they are active above ground. We quantified the thermal quality of burned and unburned habitat with respect to the tortoise by developing a habitat quality index using operative temperature models. We also recorded habitat use by tortoises, and measured tortoise body temperatures using data loggers attached to tortoises residing within and outside of a fire perimeter. Thermal quality of burned and unburned habitat was similar, but unburned habitat provided a longer daily window of potential activity time while burned habitat provided more areas available for activity at certain times of day. Body temperatures did not differ among tortoises using burned and unburned habitat suggesting that tortoises were able to thermoregulate similarly despite changes in perennial cover. Our study suggests that fire has minor effects on the thermal quality of desert tortoise habitat, but tortoises are able to compensate for this, perhaps by changing behavior or activity patterns or by shuttling between burned and unburned habitat.

Potential Effects of Renewable Energy Development on Desert Small Mammals.

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Our deserts support a diversity of small mammals (arbitrarily defined as non-volant mammals smaller than a few Kg) including a number of rare species or subspecies of conservation concern. Due in part to lack of sufficient scientific information, many of these may be overlooked when considering potential effects of renewable energy developments on native species. The Independent Science Advisors (ISA 2010) and Independent Science Panel (ISP 2012) for the California Desert Renewable Energy Conservation Plan (DRECP) recommended considering a number of small mammal taxa either as "Covered Species" (those potentially requiring "take authorizations" under state

or federal Endangered Species Acts) or as "Planning Species" (other species that might be useful in designing, monitoring, and managing a reserve system). Here I review the status, distribution, habitat needs, and potential effects of DRECP on these taxa, and summarize some recommendations for avoiding, minimizing, and mitigating impacts of renewable energy developments on them.

Populations of most small mammal taxa are unlikely to be strongly impacted (e.g., total extirpation or extinction) by DRECP actions, with a few possible exceptions. The Mohave ground squirrel (*Spermophilus* [*Xerospermophilus*] *mohavensis*) is a major focus of DRECP as a Covered Species, because it is a state-listed Threatened species that occurs at low densities in areas with very high solar energy potential, and its populations could be strongly impacted by loss and fragmentation of habitat. Most other taxa of concern are subspecies of heteromyid rodents, especially some pocket mice that have very restricted ranges in areas of high energy potential. These include the yellow-eared pocket mouse (*Perognathus parvus xanthonotus*) and Tehachapi pocket mouse (*P. alticolus inexpectatus*), both of which have very limited geographic ranges in the foothills bordering the western Mojave Desert in areas of very high wind energy potential. Another is the little-studied McKittrick pocket mouse (*P. inornatus neglectus*), which occurs in the western Mojave Desert and adjacent foothills in areas of high wind and solar energy potential where habitat has already suffered significant habitat loss and fragmentation.

Some highly endemic subspecies (or isolated populations) of the California vole (*Microtus californicus*) may be at risk if energy developments contribute to habitat loss or fragmentation, especially if increased groundwater use lowers the high water tables needed to support their herbaceous vegetation habitats. In addition to the federally and state-listed Endangered Amargosa River vole (*M. c. scirpensis*) and the narrow-endemic Mojave River vole (*M. c. mohavensis*), there are small populations of voles in scattered desert wetland areas whose taxonomic and genetic associations are poorly documented, but which may constitute unique subspecies or isolated populations worthy of conservation attention (J. Patton, C. Conroy, and S. Montgomery, personal communications). Examples include vole populations known to occur at Harper Lake Marsh, China Lake, Tecopa Hot Springs, and Little Lake.

Potential impacts to these rare and endemic mammal taxa should be considered during planning and implementation of renewable energy projects, and efforts made to avoid, minimize, and mitigate any impacts. In addition to direct impacts to habitat, potential indirect impacts should be considered, including increases in invasive plants and subsidized predators, disruption of hydrogeological processes that maintain habitat conditions, decreases in ground water, and increases in artificial lighting.

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STUDENT PAPER

Seasonal Variation in Refuge and Habitat Use in a Population of *Gopherus morafkai* at the Urban—desert Interface in Central Arizona

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We initiated a radio-telemetry study of a population of *Gopherus morafkai* in the northern Phoenix metropolitan region to assess variation in habitat and refuge use in a relatively disturbed area at the urban-desert interface. Preliminary results provide insights on three issues that will be evaluated over the next five years. First, virtually all individuals exhibited movement from lower elevation areas associated with drainages to higher elevation north-facing slopes following the monsoon rains, apparently to forage on abundant plants on those slopes. Most (~ 69%) over-wintering sites (22 of 32) were caliche refuges, either cave-slits occupied by pack rats, or tortoise tunnels, but some (~ 16%) were pack rat nests (i.e., separate from caliche formations; 5 of 32). Tunnels and caliche slits were often occupied by pairs of individuals, and up to five individuals were observed in a single tunnel. Most individuals used the same refuge in successive winters (15 of 21; 71 %). Second, some individuals made consistent long-distance movements to water catchments (e.g., rock basins at waterfalls) during rainfall events. Finally, tortoises did not avoid highly disturbed areas at the site impacted by off-road vehicles or by construction of earthen dikes, dams and roadways maintained by the county flood control district.

POSTER

The Importance of Physiology in Negotiating Climate Change in Chuckwallas

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We are analyzing physiological responses of chuckwallas (*Sauromalus ater*) in different climatic conditions naturally occurring in different seasons, and in different study sites along an elevation gradient. From these analyses, we will test whether or not chuckwalla populations are likely to persist in spite of the effects of climate change. We assessed the preferred body temperatures of chuckwallas in a laboratory thermal gradient in the spring and summer seasons. A geographical comparison of preferred body temperatures in the field, as well as measures of the thermal environments, were also assessed in two sites differing in elevation. We expect to compare our data to past meteorological records to determine the extent to which climate change has occurred in our study site. We will compare preferred body temperatures to operative temperatures, measured by operative-temperature models dispersed randomly throughout the elevation gradient spanned by our two study sites, in spring and summer. We will also compare our thermal biology data on chuckwallas with those of a study by Ted Case forty years ago from the same study site. We also measured optimal sprint-performance temperatures in chuckwallas as a way to determine the extent to which chuckwallas can accommodate changes in climate without sacrificing performance. These analyses should bear on the flexibility of this species to deal with environmental changes due to climate change.

Simulating Desert Tortoise Population Response to Anthropogenic Stressors Using Individual-based, Spatially explicit Modeling Techniques

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Desert tortoises face an assortment of anthropogenic threats that individually and cumulatively contribute to population decline. Each threat varies in both its detrimental effects to tortoise populations, and its severity and distribution in time and space. Managing threats at the local level is problematic at best; while information about the effects of some threats may be available, knowledge of the relative importance of numerous threats is generally unavailable. Identifying causal relationships between individual threats and population decline is critical to the effective prioritization of recovery efforts and funding; however, traditional field-based studies have thus far failed to identify these relationships. The desert tortoise is a long-lived organism, exhibiting delayed sexual maturity, low reproduction rates, and long generation times; therefore, it has been difficult for comparatively short-term field-based studies to mechanistically link population response to the presence or absence of specific threats. The use of an individually-based, spatially explicit population model provides an approach that can overcome

the deficiencies of field-based studies in indentifying the relationships between anthropogenic threats and population decline. Population modeling software - such as HexSim used in this analysis - allows for the examination of single threats in isolation, as well as multiple threats in concert, to determine their individual and combined effects on populations.

We developed predictive tortoise occurrence models within two study areas (Gold Butte-Pakoon and Superior-Cronese) in the eastern and central Mojave Desert. These models describe the potential for occupancy by desert tortoises based on the presence of habitat elements known to be important for the species. We imported the occurrence models into a HexSim population model and linked each model to a suite of rules that governed tortoise movement and population density. We parameterized vital rates (reproduction and survival rates) and movement behaviors based on existing information about desert tortoise biology and life history traits. We developed a stable baseline population model as a reference to assess the degree to which threats affected population decline. We simulated the threat models separately to evaluate population responses to individual threats, which allowed for comparison of each threat in causing decline in the modeled tortoise population. We simulated threats and threat types separately for each study area, and ranked the relative importance of threats in each area.

Based on this spatially-explicit model, we concluded that threats with a wide spatial distribution were more important in causing population decline than those threats that occurred over a limited area. Specifically, threats that cause habitat degradation over a broad area, such as livestock grazing and illegal off-highway vehicle use have a larger relative affect on desert tortoise population decline than patchily distributed threats that cause mortality alone, such as the presence of subsidized predator populations or road mortality. In the Gold Butte-Pakoon study area, the most important threat to the modeled tortoise populations was livestock grazing and wild burros; in the Superior-Cronese study area, human access and presence was the most important threat. Both of these threats caused the most significant decline in the modeled populations because they occur over the majority of the study areas. In contrast, the least important threat in the Gold Butte-Pakoon study area was wildfire, due to its patchy distribution in time and space. In the Superior-Cronese study area, habitat degradation on privately-owned land in-holdings, because of their patchy distribution within the study area, was the least important anthropogenic threat. Our results provide hypotheses for future field investigations, and set the stage for a re-evaluation of management priorities within each study area.

Grazing Conservation Measures in Sonoran Desert Tortoise Habitat: One Model for Agency and Landowner Collaboration

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The Natural Resources Conservation Service (NRCS) in Arizona is working with numerous agencies and landowners in a proactive approach to conserve habitat while minimizing impacts to agricultural operations. Reducing perceived or actual impediments to regular activities and conservation practices should encourage more participation from landowners in programs designed to conserve or enhance habitat. One model is the collaborative approach

NRCS, livestock producers, the Arizona Game and Fish Department and other federal agencies used to identify activities associated with livestock grazing in Arizona, the potential effects of those activities on the Sonoran desert tortoise (SDT) and the development of conservation measures to ensure compatibility with desert tortoise conservation. Conservation measures are actions or methods incorporated into conservation practices and ranching activities to eliminate or reduce the amount or magnitude of adverse effects on SDT. A draft document describing the measures is available for comment. Other programmatic approaches NRCS is engaged in include Arizona rangeland conservation practices for all listed species and range-wide consultations for the southwestern willow flycatcher and black-footed ferret.

Desert Tortoise Management and Research in Joshua Tree National Park

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Joshua Tree National Park (JOTR) protects nearly 800,000 acres of public land of which over half is considered high quality desert tortoise habitat. The park has supported the recovery of the tortoise through participation of region wide planning efforts, management of habitat, educational outreach, scientific research and line distance sampling.

JOTR managers are active participants in the Desert Managers Group (DMG) that promotes the recovery of the tortoise through education, information exchange and even a mobile app to record tortoise observations. The park management is also active in commenting on energy development projects near the park boundaries that may affect the desert tortoise. Within the park, educational specialists provide desert tortoise educational presentations to many of the local (Morongo Basin and Coachella Valley) schools. The park also has an active habitat restoration program that works to return impacted habitats to functional ecosystems for tortoises and other plants and animals.

Since 2007, the park's wildlife staff has been tracking desert tortoises near roads as part of a study to understand the effect of roads on tortoise movement patterns. Currently, the park is in its final season of data collection with some interesting preliminary results. In addition to this project, the park has assisted with the USFWS line distance sampling effort by providing both funding and data collection.

Recently, JOTR funded a study by Dr. Cameron Barrows to model desert tortoise habitat in the park. This model was then used to predict the change in habitat use by tortoises with varying levels of temperature increase and rainfall decrease associated with predicted climate shifts.

The park is also busy working with the USFWS on section 7 compliance for a campground redesign project and a road re-construction project. Additionally, the wildlife staff monitors many small projects in the park and gives many desert tortoise awareness classes to both contractors and new employees.

POSTER

Detecting Disease-Causing Bacteria Across the Geographic Range of the Desert Tortoise

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Upper respiratory tract disease (URTD) in the desert tortoise can be caused by the mollicute bacterium *Mycoplasma agassizii*. This disease has been detected in tortoises throughout the Mojave Desert, and knowing its importance as an extinction threat continues to be elusive. Thus, understanding the prevalence of *Mycoplasma* throughout the geographic distribution of the desert tortoise is extremely important, along with knowing whether mycoplasma strains are associated with increased levels of disease. We use nasal lavage to search for DNA of Mycoplasma in the upper respiratory tract of wild tortoises, and we have sampled tortoises throughout their geographic range in California, Nevada, and Utah. We used *M. agassizii*-specific DNA sequences as an indicator of presence of the bacterium, and we mapped the occurrence of *M. agassizii* throughtout the Mojave. The DNA variation we have found allows us to compare bacterial types and presence of disease signs in individuals and regions. Of the tortoises sampled, *M. agassizii* has been found in over 20 geographic areas throughout the three tortoise genotypes. This research continues as we work towards amplifying additionaly genetic loci, which will assist in phylogenetic analyses of *Mycoplasma* across the tortoise distribution. We will also use blood plasma to assess antibody presence, which will be aligned with clinical disease signs and presence of bacteria. We are expanding this research to determine mycoplasmal presence in the nares of each of the North American species of the genus *Gopherus*.

Predation of Adult Agassiz's Desert Tortoise by Common Ravens in the Central Mojave Desert

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Fieldworkers observed an adult Agassiz's desert tortoises (*Gopherus agassizii*) under attack by a common raven (*Corvus corax*) in May 2008 during the monitoring program for the Fort Irwin expansion. An adult female was on her carapace with a common raven pecking at her cloacal region. Upon approach the raven flushed and perched ~100m away; the fieldworkers observed a 1.5 cm long laceration between the tail and pygal. Bright red blood was pooled in the femoral cavities indicating the wound was recent. Since that initial observation fieldworkers have found 35 tortoises with similar wounds, all believed to be indicative of an attack by common raven(s): 2008-4, 2009-3, 2010-2, 2011-14, and 2012-14 tortoises attacked. All three groups involved with monitoring tortoises translocated for the Fort Irwin expansion have made these observations: USGS, Moreno Valley – 5; USGS, Henderson – 2; and QinetiQ – 30. The QinetiQ observations were all in one geographical region at Translocation Site 10, near the

eastern limits of the Fort Irwin Translocation Area. The USGS observations were in two regions, both west (26.5 and 38 kilometers) of the QinetiQ area. Female tortoises accounted for eighty-three percent (n=29 of 35) of the tortoises attacked. While ratios of available tortoises have not been analyzed, amongst the observations female tortoises are being attacked significantly more (STATS). Immediately after translocation in April 2008, fifty-two adult female tortoises were fitted with transmitters at Site 10. When transmitters were removed in late-July 2012, at the end of the monitoring program, 21 (40.4%) female tortoises had been attacked, 19 (36.5%) of which were killed. Two females were attacked on at least two occasions, the final attack for each being fatal. The localized nature of the attacks may indicate that few ravens are involved but common ravens are quick to learn new behaviors. They are known to be effective predators of small tortoises and if the ability to overturn and kill adult tortoises becomes widespread another threat to tortoise populations would be introduced.