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August 17, 2010

California Energy Commission
Attn: Docket Office, 08-AFC-13
1516 Ninth Street
Sacramento, CA 95814

Re: Calico Solar; Docket No. 08-AFC-13

Dear Docket Clerk:

Please process the enclosed **EXHIBITS 443-453**, conform the copy of the enclosed letter, and return the copy in the envelope provided.

Thank you.

Sincerely,

/s/
Bonnie Heeley

:bh
Enclosures

2309-095a

STATE OF CALIFORNIA

California Energy Commission

In the Matter of: The Application for Certification for the CALICO SOLAR PROJECT (Formerly SES Solar One)	Docket No. 08-AFC-13

CALIFORNIA UNIONS FOR RELIABLE ENERGY SECOND REVISED SEQUENTIAL EXHIBIT LIST FOR THE CALICO SOLAR PROJECT

August 17, 2010

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Attorneys for the CALIFORNIA UNIONS FOR RELIABLE ENERGY

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STATE OF CALIFORNIA

California Energy Commission

In the Matter of:	
The Application for Certification for the CALICO SOLAR PROJECT (Formerly SES Solar One)	Docket No. 08-AFC-13

CALIFORNIA UNIONS FOR RELIABLE ENERGY SECOND REVISED TOPIC EXHIBIT LIST FOR THE CALICO SOLAR PROJECT

August 17, 2010

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EXHIBIT 443

STATE OF CALIFORNIA
California Energy Commission

In the Matter of: The Application for Certification for the **CALICO SOLAR PROJECT**	Docket No. 08-AFC-13

TESTIMONY OF SCOTT CASHEN ON BEHALF OF CALIFORNIA UNIONS FOR RELIABLE ENERGY ON THE DESERT TORTOISE TRANSLOCATION PLAN FOR THE CALICO SOLAR PROJECT

August 17, 2010

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FOR RELIABLE ENERGY

2309-096a

The following testimony addresses the practice of translocation of desert tortoise as it relates to the Calico Solar Project (Project) proposed by Tessera Solar (the Applicant). The testimony explains that recent experiences at other sites show that translocation does not constitute a valid mitigation measure. The testimony also addresses specific deficiencies in the Applicant's proposed translocation plan, which it distributed to parties in the Calico proceeding on August 5, 2010.

Translocation is defined as the movement of living organisms from one area, with free release in another.[1] Accidental and intentional translocations may have multiple unintended negative consequences, including increased stress and mortality of relocated animals, negative impacts on resident animals at release sites, increased conflicts with human interests, and the spread of diseases. Many wildlife professionals now question the practice of desert tortoise translocation, particularly in light of the consequences at Fort Irwin.

I. INTRODUCTION

The Army is converting over 100,000 acres of land at Fort Irwin into useable military training lands. The original Biological Opinion issued by the U.S. Fish and Wildlife Service (USFWS) included several avoidance and minimization measures to be implemented by the Department of the Army to offset impacts to listed species, including the federally threatened desert tortoise.[2]

One of the "Reasonable and Prudent Measures" in the original Biological Opinion included the translocation of desert tortoise from the expansion areas to an area outside the Fort Irwin boundary. Under the Proposed Action, the Army would translocate desert tortoises in the expansion areas onto federal lands managed by BLM for desert tortoise conservation and Army lands purchased from Catellus Corporation as mitigation for the Fort Irwin Expansion.

To effect the translocation of desert tortoises from the 24,000-acre "Southern Expansion Area" (SEA), the Army, working with the United States Geological Survey (USGS) and other agencies, prepared an initial translocation plan for the SEA (hereinafter referred to as the Fort Irwin Translocation Plan). In 2008, a review of the original Fort Irwin Translocation Plan resulted in the development of a revised plan. In 2009, scientists from the USGS and University of Nevada-Reno, working in consultation with wildlife agencies, developed an amendment to the original Fort Irwin Translocation Plan. The Amended Fort Irwin Translocation Plan includes modifications in animal release (animals released over a larger area, thus reducing release density), disease and health screening (modified protocols), and monitoring in response to the preliminary results from the SEA translocation efforts.

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[1] IUCN. 1987. IUCN Position Statement on Translocation of Living Organisms: Introductions, reintroductions, and Re-Stocking. Prepared by the Species Survival Commission in collaboration with the Commission on Ecology, and the Commission on Environmental Policy, Law and Administration. Approved by the 22nd Meeting of the IUCN Council, Gland, Switzerland, 4th September 1987.

[2] [BLM] Bureau of Land Management. 2009 Jul 31. Environmental Assessment for the Translocation of Desert Tortoises onto Bureau of Land Management and Other Federal Lands in the Superior-Cronese Desert Wildlife Management Area, San Bernardino County, California. BLM Environmental Assessment CA-680-2009-0058. BLM, Barstow Field Office.

In order to analyze the effect of translocation of tortoises within the translocation study area, researchers have been collecting and analyzing data on tortoises that have been tracked (via radio-telemetry) since late March 2008.[3] Although this study is ongoing, the preliminary conclusions based on the second year of data indicate that translocated tortoises are experiencing very high levels of mortality.

A. Preliminary Results from SEA Study

Long-term objectives of the SEA translocation study include modeling and predicting effects of translocation on survival of tortoises by health status, presence of infectious diseases and trauma, size and age class, and sex. In late March of 2008, 158 adult and subadult tortoises (82 females and 76 males) were translocated from the SEA to four plots located in the Superior-Cronese Desert Wildlife Management Area (DWMA).

Survivorship-

Within nine months of being translocated (i.e., by December 2008), 43 (27%) of the initial 158 translocated tortoises had been found dead or had been salvaged for necropsy, and an additional 15 (13%) of the tortoises were missing.[4] Between January and December of 2009, 27 (23.5%) of the remaining 115 live and missing tortoises were found dead. Of these 27 tortoises, 24 were probably killed by coyotes or other canids, one was killed by a vehicle, and 2 died of unknown causes. Overall, since the translocation began in March of 2008, 44.3% of tortoises have been found dead or were salvaged for necropsy. In addition, by the end of 2009, an additional 20 (22.7%) of the remaining 88 tortoises were missing. In summary, within approximately 21 months of being translocated, 90 (57%) of the 158 tortoises that were translocated were either killed or are considered missing.

Health-

During 2009, the research team conducted health evaluations for clinical signs of health, disease, and trauma for 81 tortoises in the spring and 65 tortoises in the fall. In the spring, four (4.9%) and two (2.5%) tortoises had positive or suspect enzyme-linked immunoassay (ELISA) tests for *Mycoplasma agassizii* and *M. testudineum,* respectively (i.e., Upper Respiratory Tract Disease). In the fall, 6 of 65 (9.2%) tortoises tested positive or suspect for *M. agassizii*; none had positive or suspect tests for *M. testudineum*. Overall during 2009, 9 of 81 individual tortoises (11.1%) had ELISA test results that were positive or suspect for *Mycoplasma* species. When weights of tortoises were compared for 2008 and 2009, spring weights were significantly higher than fall weights. In addition, weights in fall 2009 were significantly lower than weights in fall 2008.

The results for the second year of the SEA translocation study reveal that the death rate of

[3] Gowan and Berry. 2009. Progress Report on the Health Status of Translocated Tortoises in the Southern Expansion Area. 2009 Annual Progress Report, Appendix 3.
[4] Gowan and Berry. 2009. Progress Report on the Health Status of Translocated Tortoises in the Southern Expansion Area. 2009 Annual Progress Report, Appendix 3.

translocated tortoises in the sample population is extremely high. Over half of the translocated tortoises tracked by the study are dead or missing. The data also indicate that there was no significant decrease in the rate of mortality during the second year. The study suggested that the presence of disease and weight loss in the sample population may also contribute to mortality both from predation and other causes. In short, the sample population from the SEA translocation study has experienced disaster. These results provide strong evidence that translocation of desert tortoise *does not work as a mitigation strategy*.

B. Anticipated Results of the Calico Solar Desert Tortoise Translocation Plan

The Fort Irwin translocation project is the most recent, large-scale project involving translocation of desert tortoises. It has incorporated extensive financial and personnel resources, rigorous scientific study and monitoring, and tortoise health assessments that incorporate novel and extensive laboratory analysis. Arguably, it incorporated the best available scientific information on the techniques and analyses necessary to promote survivorship of translocated tortoises. Despite these well-intentioned efforts, the SEA translocation study shows that the Fort Irwin translocation project has failed to provide a viable solution to prevent desert tortoise deaths.

Given the results of the Fort Irwin translocation project, one can develop a strong inference on the fate of the 131 to 185 tortoises that the Applicant proposes to translocate off the Calico Solar Project site (hereafter referred to as the "Project"): *most are likely to die*. Selection of appropriate translocation sites, health evaluation techniques, and remedial action measures each are critical considerations of a desert tortoise translocation plan. By comparing the Applicant's Desert Tortoise Translocation Plan with the plans that were developed for Fort Irwin, one can further develop an inference on the likely fate of the tortoises the Applicant proposes to translocate:

1. *Selection of translocation sites*:
    a. Fort Irwin: Collaborative effort among USGS, University of Redlands, and University of Nevada, Reno scientists to develop a decision support model that identified and prioritized possible translocation sites.[5] Model was based on geospatial data used in an expert-opinion model of habitat potential, threats to tortoises, recent tortoise surveys, and several anthropogenic factors (i.e., land use, ownership, urban planning) that were considered to be important to the survival of tortoise populations. Scientists conducted field investigations to validate model's prediction of suitable translocation sites.
    b. Calico Solar: Subjective data derived from incomplete field surveys. Omission of many of the habitat variables evaluated by the Fort Irwin Team. Limited field data that does not support selection of the "potentially suitable" sites identified.
2. *Disease testing:*
    a. Fort Irwin: Disease screening and genetic sampling before tortoises were

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[5] Esque TC, KE Nussear, PA Medica. 2005 Jul 25. Desert Tortoise Translocation Plan for Fort Irwin's Land Expansion Program at the U.S. Army National Training Center (NTC) & Fort Irwin. Available from USGS, Western Ecological Research Center, Las Vegas Field Office. p. ii.

removed from their original habitat.[6] Visual assessment for herpes lesions, URTD symptoms, trauma, and cutaneous dyskeratosis according to the methods described by Berry and Christopher (2001). Blood sampling and laboratory analysis to identify diseases, genetics, and stress levels (when possible). Supplementary plan for tortoises that tested positive for disease. Revision of health evaluation procedures as new information became available, including (i) recommendations on blood drawing, handling, and analysis procedures; (ii) timing and frequency of blood testing required to minimize disease transmission; and (iii) development of a decision tree that prescribes the appropriate management action for each tortoise.

b. Calico Solar: No blood sampling has been completed. No visual health assessment of many of the tortoises detected during field surveys of the Project and proposed translocation sites. Translocation of tortoises before laboratory analysis is completed. Reliance on the traditional approach to developing a list of diseases of concern and testing candidates for those diseases. Vague information on the fate of tortoises testing positive for disease, or that may exhibit false positive or false negative results.

3. *Criteria for disease testing and short-distance translocation:*

   a. Fort Irwin: Monitoring data reveal the problems associated with traditional assumptions on what constitutes a "short-distance" translocation and when disease testing should be required. Recommendation that adult male tortoises should be translocated within 340 meters (m) of their homes sites, and adult females within 250 m.[7] Conclusion that translocating a tortoise with an infectious disease, even a short distance, is unwise.[8]

   b. Calico Solar: Translocation of tortoises up to 500 m without disease testing. Unsubstantiated assumption that tortoises moved a "short-distance" would likely remain within their home range. Unsubstantiated assumption that disease testing is unnecessary for short-distance translocations. Incorporation of incorrect information on the distribution and abundance of tortoise diseases.

4. *Consideration of translocation guidelines provided by the Desert Tortoise Recovery Plan:*

   a. Fort Irwin: Guidelines addressed and considered.

   b. Calico Solar: Guidelines not addressed and no apparent consideration given.

5. *Metrics of success and triggers for adaptive management*:

   a. Fort Irwin: Specified 17 different metrics of success (including both short-term and long-term metrics). Specified triggers for adaptive management. Implemented adaptive management.

   b. Calico Solar: Identifies measurements used to determine the success of the

[6] *Id,* p. 20.
[7] Berry KH. 2009. Draft Decision Tree for Short-distance Translocation of Desert Tortoises. Available from USGS, Western Ecological Research Center, Las Vegas Field Office.
[8] Berry KH. 2009. Draft Decision Tree for Short-distance Translocation of Desert Tortoises. Available from USGS, Western Ecological Research Center, Las Vegas Field Office.

proposed translocation effort, but does not provide any metrics of success or triggers for adaptive management.

II. DISCUSSION

The U.S. Fish and Wildlife Service's Biological Opinion for the Fort Irwin translocation plan required the Army to fund research on the effects that translocation activities have on tortoise populations in order to inform future translocation efforts in the Mojave Desert.[9] Much of the Fort Irwin research is available in annual monitoring reports released by the Army; in peer and non-peer reviewed literature; and in papers presented at the Desert Tortoise Council Symposia (among other open sources). Despite extensive planning and preparation, the Fort Irwin plan is considered a failed effort among biologists tracking its results. Generally, the Applicant's Desert Tortoise Translocation Plan (hereafter referred to as "Translocation Plan" or "Plan") failed to build on the lessons learned from Fort Irwin. Instead, the Applicant has submitted a Desert Tortoise Translocation Plan with little scientific rigor, and it is plagued by a lack of planning and effort. Were the Translocation Plan implemented as currently proposed, it is my professional opinion that translocation of desert tortoises from the proposed Project site would very likely result in significant desert tortoise mortality, contributing to further declines of the species.

As discussed in detail below, identifying suitable release sites is a critical component of any translocation plan. The Translocation Plan states: "[s]urvivorship may be maximized if DETO [desert tortoise] are translocated into habitat of similar or better quality to their original home range, as well as within a nearby population with a similar genetic composition. The proposed recipient area should also be contiguous, with ample additional suitable habitat beyond the recipient area into which translocated and/or resident DETO can move."[10] The Translocation Plan goes on to state, "[p]rotocol surveys of all potential recipient sites were conducted to determine the density and observed health of the resident population and to evaluate the habitat quality of these recipient sites."[11]

Below, I discuss the various factors the Applicant claimed it evaluated to select appropriate translocation (or recipient) sites.

A. HABITAT SUITABILITY

In a comprehensive review of translocation projects involving birds and mammals, Griffith et al. (1989) concluded overall success rates were apparently dependent on a variety of ecological factors, including the quality of the habitat where animals were released. When an animal is moved to an unfamiliar location, it has no knowledge of the habitat resources essential for its survival (e.g., food, water, and cover). The lack of cover in an unfamiliar setting makes a prey species an easy target for predators. In addition, many animals, including the desert tortoise,

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[9] Boarman WI, AP Woodman, A Walde. Moving Day: Large-scale translocation of Desert Tortoises at Fort Irwin, California [Abstract]. 2008. Thirty-third Annual Meeting and Symposium; 2008 Feb 22-25, Las Vegas. The Desert Tortoise Council. Available from: http://www.deserttortoise.org/symposia.html.

[10] Desert Tortoise Translocation Plan Calico Solar Project, July 28, 2010 (Distributed August 4, 2010), Ex. 93, p. 2-1. ("Desert Tortoise Translocation Plan").

[11] Desert Tortoise Translocation Plan, Ex. 93, p. 2-2.

exhibit an intrinsic homing response that is energetically taxing, and that may preclude procurement of food and cover resources. Elevated stress hormone levels an organism generates when it is handled and moved may synergistically interact with increased energetic demands to further reduce possibility of survival. Even if the translocated animal is placed in an area with readily available resources, aggressive competitors may prevent the displaced animal from accessing the resources, and from mating. Each of these factors exemplifies the need to conduct a thorough habitat suitability analysis before translocation occurs.

USGS Habitat Model

According to the Translocation Plan, the lands the Applicant identified as potential areas suitable for translocation "were delineated based on DETO habitat suitability as modeled by the United States Geological Survey (USGS) (2009) (Figure 3), and land use and ownership of areas proximal to the Project site (Figure 4)."[12] The Translocation Plan goes on to state:

> "The USGS suitability mapping is based on a complex model that resulted in model scores of 0 to 1 (Nussear et al. 2009). Model scores reflect a hypothesized habitat potential given the range of environmental conditions where DETO occurrence was documented. When compared to known DETO distribution, the mean model score for all DETO presence cells was 0.84, and 95 percent of the cells with known presence had a model score greater than 0.5."[13]

The information provided by the Applicant is **incorrect**. The USGS reported: "[t]he mean model score for all tortoise presence cells was 0.84, and 95% of the cells with known presence had a model score **greater than 0.7** (Fig. 7)."[14] The Translocation Plan did not provide model scores for the proposed translocation and control sites. However, if the Applicant used 0.5 as a model score above which lands were considered suitable for translocation (as suggested in Figure 2 of the Translocation Plan), it has vastly overstated the amount of potentially suitable translocation sites predicted by the model. Ample translocation sites that are verified by empirical field data must be identified *before* the Applicant begins clearing tortoises off the Project site, or else tortoises may unnecessarily die.

The USGS habitat model is a valuable tool, but one that has limitations. As the Plan acknowledged, "[i]t is important to note that there are limitations to the model, and there are likely areas for which habitat potential was predicted not to be high. Likewise, there are likely areas of low potential for which the model predicted higher potential."[15] Despite acknowledging the limitations of the model, the Applicant's Translocation Plan relies heavily on the model's predictions in the selection of suitable translocation sites. Unless the Applicant makes an attempt to account for the limitations of the model, it is likely to translocate tortoises to areas that it has falsely concluded have high quality habitat.

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[12] Desert Tortoise Translocation Plan, Ex. 93, p. 2-15.
[13] Desert Tortoise Translocation Plan, Ex. 93, p. 2-1.
[14] Page 12 of USGS Habitat Model.
[15] Desert Tortoise Translocation Plan, Ex. 93, p. 2-1.

Field Surveys

The Translocation Plan suggests the habitat suitability of the proposed translocation and control sites was (or in most cases ***will*** *be*) determined by field surveys that evaluate the: (1) density of resident tortoise; (2) observed vegetation cover and forage quality; (3) proportion of animals exhibiting signs of disease; (4) level of disturbance (grazing, agriculture or roads); (5) presence of native and non-native vegetation (i.e., weeds); (6) soil/substrate composition; (7) topography; (8) general landform type; (9) presence of forage; and (10) presence of desert tortoise and/or desert tortoise sign including burrows and scat.[16] The goal is that evaluation of these variables enables the Applicant to compare the habitat on the Project site with habitat at the proposed recipient sites and control sites. Yet, the Translocation Plan provides **no data** on most of these variables, and it makes numerous references to the fact that additional surveys are required. In other words, the plan identified a method for evaluating habitat at translocation and control sites but failed to actually utilize the method and report conclusions. As a result, the Translocation Plan has not provided the information necessary to compare the habitat at the proposed recipient sites (and control sites) with the habitat at the Project site. The wildlife agencies and public cannot evaluate the potential efficacy of the Plan until the Applicant has completed a proper comparison of relative quality among the identified sites.

Although the Translocation Plan made several references to the Applicant having conducted protocol desert tortoise surveys of the proposed translocation sites and the control area, many of **these surveys have not been completed**, and they apparently would not be completed until after Project approval and the Applicant has begun clearing tortoises from the Project site**.** This would be unacceptable because the Applicant has not disclosed which portions of the translocation sites and control areas have been surveyed, and which portions still need to be surveyed. The Applicant's proposed translocation project cannot succeed if translocation sites are not thoroughly evaluated and deemed suitable before translocation begins so that unsuitable areas are avoided.

Instead, the Applicant is using desert tortoise density estimates to determine how many tortoises can be translocated without exceeding carrying capacity. Tortoises move, reproduce, and die. Because the Applicant failed to complete the protocol surveys within a distinct timeframe, it will be unable to combine data obtained during spring 2010 with future survey data (i.e., from the areas that have not yet been surveyed) to generate accurate density estimates for each proposed translocation site (and the control site).

The Applicant has not provided information on the individuals that conducted the protocol surveys, including their qualifications and prior experience. The U.S. Fish and Wildlife Service (USFWS) requires protocol desert tortoise surveys be conducted by individuals that have demonstrated their qualifications and experience.

Ultimately, the Translocation Plan conceded that "the proposed recipient areas might be further refined based on the site characterization and disease testing results."[17] Therefore, although the Applicant proposes to start translocating tortoises off the Project site in 6 to 10 weeks (i.e.,

[16] *Id.*
[17] Desert Tortoise Translocation Plan, Ex. 93, p. 2-2.

October 2010), it has **yet to identify the specific translocation sites or collect the data necessary to support their selection**. From a scientific perspective, this is completely unacceptable. The wildlife agencies can only evaluate and approve a fully realized plan.

B. DENSITY/CARRYING CAPACITY

Determining the carrying capacity of a site for desert tortoises is difficult due to the lack of data available to the scientific community.[18] Whereas the USFWS has established guidelines for estimating current desert tortoise population sizes, very little data exists that allows land managers to accurately predict how many individuals a site may safely support (i.e., the carrying capacity). In addition, any assumptions that rely on carrying capacity estimates must account for temporal differences in water resources, forage abundance, and other desert tortoise population parameters. In addition to failing to address the challenges associated with estimating carrying capacity, the Applicant's poorly formulated Translocation Plan contains far too many inconsistencies and omissions that would pose significant risks were translocation efforts carried out as proposed.

According to the Translocation Plan, the baseline density of desert tortoises from which to base translocation capacity is 12.2 per square mile, and that "agency input" determined the number of relocated individuals should be limited to 130% of this baseline density.[19] Therefore, the Applicant has defined 15.5 tortoises per square mile as the maximum density allowed at recipient sites with good quality habitat and no disease. Lesser quality habitat will have a lower maximum density.[20] However, the Translocation Plan omitted reference to the context in which this agency input was given and the quantitative data upon which this determination was based. The Translocation Plan also omits the density thresholds for what it terms medium quality and low quality habitat, which are crucial pieces of information for an accurate spatial distribution of translocated tortoises across sites of mixed quality.

Furthermore, if a site is characterized by good habitat and has the baseline density of 12.2 tortoises per square mile, it can receive up to 5 additional individuals per square mile.[21] Quite simply, this increases the site density to 17.2 desert tortoises per square mile, which is almost 2 individuals above the 15.5 threshold established by the Translocation Plan. This apparent mathematical error erodes many of the Applicant's assumptions and proposed translocation activities.

The Applicant used density estimates and the size of the various recipient sites to determine how many desert tortoises could be moved into each location. However, the Applicant has not provided any data to support its density estimates. According to the Applicant, the 942-acre (1.42 square miles or 3.8 square km) Pisgah ACEC translocation area can receive up to 11 individuals.[22] According to the Applicant, the 1,591-acre (2.49 square miles or 6.4 square km) "Northern Linkage Area" is able to support an additional 2 tortoises per square mile (i.e., 5

[18] Appendix 1, FT Translocation Plan, p. 55.
[19] Desert Tortoise Translocation Plan, Ex. 93, p. 2-4.
[20] *Id.*
[21] *Id.*
[22] Desert Tortoise Translocation Plan, Ex. 93, p. 2-14.

additional tortoises). The Applicant proposes to move the rest of the desert tortoises found on the project site to locations in the Ord-Rodman DWMA. However, the Translocation Plan specifically states that the proposed DWMA locations can support *up to* 60 translocated tortoises. Therefore, the Applicant identified *potentially* suitable translocation sites for 76 tortoises (assuming disease does not occur within any of the recipient sites thereby eliminating them). According to the Translocation Plan, an estimated 131 (but possibly as many as 185) tortoises must be moved off the Project site.[23] The Applicant does not have a plan for the 55 to 109 remaining tortoises requiring translocation (42% to 59% of the population that occurs on the Project site). This error must be remedied before any plan can be implemented.

C. VEGETATION COVER AND FORAGE QUALITY

For the Fort Irwin translocation project, Dr. Kristin Berry reported "[t]he presence and availability of high quality forage for tortoises are essential to survival of the tortoises and long-term success of translocation efforts. Prior to translocation, data should be collected and analyzed on annual biomass in late winter, spring, summer and fall (with an emphasis on key forage species in spring), and the home sites of tortoises compared with potential release sites."[24] The Applicant's Translocation Plan does not provide any quantitative data on the presence, abundance, and distribution of forage on the translocation and control sites. Furthermore, the Applicant's field survey data sheets suggest evaluation of forage (or other vegetation characteristics) was not the focus of the survey team. Indeed, the Applicant has provided no real indication that the proposed translocation sites have the vegetation characteristics necessary to support translocated tortoises, an essential component of success.

D. DISEASE

Disease is one of the primary threats to desert tortoise populations. Consequently, minimizing the spread of disease is a central protection strategy, and careful screening of animals is one of the most important components of a translocation project (i.e., to avoid exposing healthy tortoises to diseased tortoises).

Yet the Applicant has only conducted a visual health assessment of tortoises detected during surveys of the proposed recipient and control sites. The Applicant has not conducted any blood testing, which is the required method for reliably distinguishing between sick and healthy tortoises. Mere visual inspections are not adequate. A visual health assessment cannot be used in connection with a translocation plan, or to support the proposed translocation sites. Furthermore, information provided by the Applicant's data sheets and resumes indicate the health assessments may not have been conducted by qualified individuals.

Worse, even the Applicant's visual assessment provided little value as a potential screening tool. For example, the Applicant submitted 19 "Live Tortoise Encounter" forms associated with surveys of the long-distance translocation site "DWMA 1." Of these, seven forms provided no

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[23] Desert Tortoise Translocation Plan, Ex. 93, p. 1-2; 2-15.

[24] Berry KH. 2009. An Evaluation of Desert Tortoises (*Gopherus agassizii*) and Their Habitats at 47 Sample Plots in the Western Expansion Translocation Area, Fort Irwin Translocation Project, San Bernardino County, California. Appendix 4.

information on the health of the tortoise that was detected (i.e., the portion of the form dedicated to health assessment was left blank) and five forms indicated health was "unknown." Thus, the Applicant was unable to assess the health of 63% of the tortoises detected, and the suitability of DWMA 1 as a potentially disease-free location rests on a visual health assessment of seven tortoises.

E. DISTURBANCE

The Translocation Plan was correct that "suitable areas for translocation would not include high incidences of anthropogenic disturbance (e.g., highly fragmented by roads, off-highway vehicle activity, etc.)."[25] The Applicant did not define what it considers "high incidences," nor does it discuss how levels of disturbance were evaluated. The Translocation Plan provided no discussion of off-highway activity or road density at the proposed sites, the only two sources of disturbance that it referenced. The data sheets that the Applicant provided for "DWMA 1" and "DWMA 2" (the Applicant has not provided data sheets for the Pisgah ACEC and the control site) do not provide information on disturbance, nor does it appear the field crew was instructed to evaluate this variable (the data sheets do not have a location for the field crew to enter information on disturbance).

The limited information that the Translocation Plan provided on disturbance at the proposed translocation lands may have been derived from a subjective assessment of limited portions of the proposed recipient and control sites. Moreover, it appears to be biased. For example, in discussing the proposed Pisgah ACEC translocation area, the Translocation Plan states "[h]abitat in this area does not currently appear to be fragmented as a result of the road or transmission line."[26] However, the road and transmission line, by definition, have already fragmented the area. Thus, the Applicant's statement contravenes both the definition of fragmentation and conventional wisdom. Importantly, in describing threats to desert tortoise populations, Boarman (2002) indicated roads, railroad tracks, and other developments were examples of anthropogenic factors that fragment desert tortoise habitat in the West Mojave Desert.[27] Boarman (2002) further reported:

> Corridors formed by utility and energy rights-of-way cause linear impacts to populations and may have levels of impacts well beyond those of many point sources of impacts. In a retrospective evaluation of results of 234 Biological Opinions issued by USFWS in California and Nevada (LaRue and Dougherty 1999), 80% (47/59) of the tortoises reportedly killed in California and Nevada were killed along utility corridors…Considerable habitat destruction or alteration occurs when pipelines and transmission lines are constructed and the impacts are repeated as maintenance operations or new pipelines or power lines are placed along existing corridors…Dirt roads used for maintenance-related access create dust (Wilshire 1980) and provide access to less disturbed habitat (Brum et al. 1983). The habitat conversions during early stages of post-construction succession along pipeline corridors (Vasek et al. 1975) not only may suppress regular use by

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[25] Desert Tortoise Translocation Plan, Ex. 93, p. 2-14.
[26] Desert Tortoise Translocation Plan, Ex. 93, p. 2-17.
[27] Boarman WI. 2002. Threats to Desert Tortoise Populations: A Critical Review of the Literature. U.S. Geological Survey, Western Ecological Research Center. Sacramento (CA): 86 p.

> tortoises, but may function to reduce dispersal across the corridor thus effectively fragmenting a previously intact population...The presence of transmission towers in areas otherwise devoid of other raven nesting substrates (e.g., Joshua trees, palo verdes, cliffs), may introduce heavy predation to an area previously immune to such predation (Boarman 1993)…By one estimate, ravens probably do most (75%) of their foraging within 400 m of their nest (Sherman 1993) and raven predation pressure is notably intense near their nests (Kristan and Boarman 2001). Therefore, ravens nesting on transmission towers, where no other nesting substrate exists within about 800 m, may significantly reduce juvenile tortoise populations within 400 m of the corridor, but this effect is quite localized…Data collected along paved highways indicate that road kills can substantially reduce tortoise populations within at least 0.4-0.8 km of such roads.[28]

The following issues related to disturbance were either not addressed, or not adequately considered, in the Applicant's Translocation Plan:

1. The Applicant has documented at least one raven nest along the transmission line route between the Project site and the proposed Pisgah ACEC short-distance translocation area. To avoid having to conduct disease testing, the Applicant proposes to translocate tortoises adjacent to the transmission line, which is the area where any ravens nesting in transmission towers would do most of their foraging.[29] Ravens are an undisputed threat to desert tortoises.
2. Pisgah Road is a source of disturbance that bisects the proposed Pisgah ACEC translocation area. Pisgah Road was omitted from all of the maps accompanying the Applicant's Translocation Plan, and it was not mentioned in the body of the plan. To avoid having to conduct disease testing, the Applicant proposes to translocate tortoises between Pisgah Road and the transmission line—two major sources of disturbance.
3. Pisgah Road leads to Black Butte Mine, which is immediately adjacent to the proposed Pisgah ACEC translocation area. Black Butte Mine is an additional source of disturbance omitted from the Applicant's Translocation Plan.
4. Portions of the proposed long-distance translocation sites (i.e., DWMA 1 and DWMA 2) are within the average distance desert tortoises may range following a translocation.[30] Interstate 40 and the National Trails Highway are located between the translocation sites and the Project site. Neither of these roads appears to have desert tortoise exclusion fencing. Translocated tortoises that attempt to return to their home ranges on the Project site would be subject to mortality as they attempt to cross the roads. If any tortoises *are* able to successfully cross the roads, they would then be trapped in the road shoulder between I-40 and the Project's fencing. These tortoises would most likely die due to vehicle collision, predation, illegal collection, or any host of the numerous other threats associated with roads and anthropogenic disturbance. The Applicant's Translocation Plan does not address this reasonably

[28] *Id.*
[29] *Id.*
[30] Desert Tortoise Translocation Plan, Ex. 93, p. 1-2.

foreseeable threat to translocated tortoises.

5. In the AFC, the Applicant reported "[d]eveloped lands (Holland Code 12000) include roads, built structures, and associated infrastructure. Within the Project Area, these included *dirt roads, transmission lines*, underground gas pipelines, railroads, and any other built environments."[31] The Translocation Plan provides no justifiable explanation for why dirt roads and transmission lines should be categorized as "developed lands" on the Project site, but not be considered disturbance (or a source of fragmentation) within the proposed translocation areas.
6. If built, proposed renewable energy projects would completely surround the proposed Pisgah ACEC translocation area.[32] Because desert tortoises require large blocks of intact habitat, the tortoise population that remains in the Pisgah ACEC translocation area (i.e., current residents and translocated tortoises) is unlikely to remain viable.
7. The Project requires expansion of the existing Pisgah Substation. Substation expansion would directly impact 40 to 100 acres of land adjacent to or within the Pisgah ACEC.[33] The Applicant's Translocation Plan does not address this reasonably foreseeable threat to translocated tortoises in the proposed Pisgah ACEC translocation area.

F. NON-NATIVE VEGETATION

Despite having identified non-native vegetation as a factor that influences desert tortoise habitat suitability, the Applicant has not collected any quantitative data on the presence, abundance, and distribution of non-native vegetation on the translocation and control sites.

The limited qualitative information that the Translocation Plan provides on non-native vegetation shows evidence of bias. In discussing the Pisgah ACEC translocation site, the Applicant reported "[t]he habitat compares directly to areas of the Project site adjacent to this area. Some non-native species were observed in this area, consisting of small isolated patches of Sahara mustard; however, it did not occur in large enough patches to pose a risk for infestation."[34] In contrast, the Applicant's Draft Noxious Weed Management Plan reported Sahara Mustard was "widespread and abundant throughout [Project] site" and that it is a weed that is "highly invasive."[35] The two areas are in relative close proximity of one another and share the same ecosystem. Thus, Sahara Mustard is likely to respond identically at both sites.

G. SOIL/SUBSTRATE

Desert tortoises require friable soils for constructing burrows. As a result, soil types (or substrate) may be a limiting factor for tortoise occupancy and abundance. The Applicant has not collected any quantitative data on the suitability of burrow substrates within the translocation and control sites.

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[31] AFC, p. 5.6-5. [emphasis added]
[32] Figure 3.
[33] CEC Staff's Errata to the Supplemental Staff Assessment (August 4, 2010) p. B.3-16.
[34] Desert Tortoise Translocation Plan, Ex. 93, p. 2-3.
[35] URS Corp. 2009 Mar 31. Draft Noxious Weed Management Plan. p. 6-1 and Table 1.

Soil friability is measured by the distribution of flaws or microcracks within it, and estimates of friability generally entail laboratory tests or use of specialized field equipment.[36] As with other estimates, replicate measurements are required to obtain accuracy. During the 5 August 2010 evidentiary hearings, the Applicant's consultant (Theresa Miller) testified that the consulting team did not dig any soil pits (or otherwise implement any accepted friability tests). Therefore, there is no evidence of the suitability of the translocation lands for tortoise burrowing.

H. TOPOGRAPHY

The Translocation Plan indicates suitable translocation areas must have slopes less than 20 percent.[37] The Translocation Plan provides a general discussion of slope, but it does not provide any actual data on the slopes within the proposed translocation and control sites. During the 5 August 2010 evidentiary hearings, the Applicant's consultant (Theresa Miller) testified that the consulting team did not use clinometers or other equipment to measure slope.

I. LANDFORM TYPE

The Translocation Plan identifies landform type as a factor that influences desert tortoise habitat quality.[38] However, the Translocation Plan does not provide any discussion of the relationships among landform types, habitat quality, and the landforms within the proposed translocation and control sites.

J. DESERT TORTOISE AND/OR DESERT TORTOISE SIGN

Besides the USGS habitat model, the abundance of desert tortoise and sign was the main factor the Applicant used to establish habitat quality. The Translocation Plan reports:

> "[t]he main factor in determining whether habitat demonstrated high quality was based on the presence of DETO and DETO sign. When comparing this measure to the other factors used to determine high quality habitat, several factors were found to correlate well. In addition to containing a high number of DETO and DETO sign, high quality habitat also showed little to no evidence of disturbance, contained little to no weed infestations, and had a uniform and dense cover of forage (annual wildflowers). Physically, the higher quality habitat areas also were located in the transition zones between the foothills and flatter alluvial valleys. These areas were also typically characterized as having a moderate amount of small washes, with gravelly to rocky substrate suitable for burrowing by DETO."[39]

Use of desert tortoise abundance or density to establish habitat quality is a fatal flaw that permeates the entire Translocation Plan. Several types of limitations and ecological processes

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[36] Dexter, A.R. and C.W. Watts. 2000. Tensile strength and friability. In: Soil and environmental analysis. Physical methods. (Eds: K.A. Smith and C.E. Mullins), 2nd ed. Marcel Dekker, New York, pp. 401-430.
[37] Desert Tortoise Translocation Plan, Ex. 93, p. 2-17.
[38] Desert Tortoise Translocation Plan, Ex. 93, p. 2-2.
[39] *Id.*

must be considered when density data are used to evaluate habitat quality.[40] For example, higher-quality habitats may be occupied by dominant individuals, forcing subdominants into lower-quality habitat. Thus, higher densities may be present in poorer, not better, habitats.[41] During the 5 August 2010 evidentiary hearings, the Applicant's consultant (Theresa Miller) testified that the desert tortoise is a territorial organism (i.e., one in which an individual will defend resources from other individuals). Indeed, the Translocation Plan itself presents numerous examples in which the Applicant violated its own premise about the relationship between abundance and habitat quality. For example, in discussing the suitability of proposed translocation area "DWMA 1", the Translocation Plan states "[d]espite the similarity of this site to the high quality habitat on the Project site, burrows and DETO were not found in the quantities expected. Caliche caves were abundant in the banks of the numerous washes, but little DETO sign was noted in or around the majority of them."[42] The Translocation Plan then proceeds to the conclusion that "the habitat here appears to be high quality."[43] For proposed translocation area "DWMA 2", the Applicant presents the conclusion that "[r]egardless of the high number of carcasses found here, this area is high quality habitat."[44] The conclusion begs the question, if DWMA 2 provides such high quality habitat, why have so many tortoises died?

Additional flaws with the Applicant's justification include the following:

1. The Translocation Plan provides no evidence or analysis that "several factors were found to correlate well" (as suggested). Examination of correlation requires at least simple statistical analysis, which the Applicant did not conduct.[45]
2. The Translocation Plan provides no data to support the conclusion that "high quality habitat also showed little to no evidence of disturbance, contained little to no weed infestations, and had a uniform and dense cover of forage (annual wildflowers)."
3. The Translocation Plan's conclusion that "[p]hysically, the higher quality habitat areas also were located in the transition zones between the foothills and flatter alluvial valleys. These areas were also typically characterized as having a moderate amount of small washes, with gravelly to rocky substrate suitable for burrowing by DETO" constitutes post hoc analyses. In addition to this fallacy, one can only guess what constitutes a "moderate amount" and what constitutes a "small" wash.

K. PREDATOR DENSITY

Predation has been identified as the number one cause of mortality in the Fort Irwin translocation effort. Incredulously, the Applicant's Translocation Plan provides no data, evidence, or discussion on predator levels in the proposed translocation and control sites. The abundance and

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[40] Anderson SH. 1981. Correlating habitat variables and birds. Pages 538-542 in CJ Ralph and JM Scott, editors. Estimating numbers of terrestrial birds. Studies in Avian Biology 6.
[41] McDonald LL, JR Alldredge, MS Boyce, and WP Erickson. 2005. Measuring Availability and Vertebrate Use of Terrestrial Habitats and Foods. Pages 465-488 in CE Braun, editor. Techniques for Wildlife Investigations and Management. The Wildlife Society, Bethesda (MD).
[42] Desert Tortoise Translocation Plan, Ex. 93, p. 2-18.
[43] Desert Tortoise Translocation Plan, Ex. 93, p. 2-19.
[44] *Id.*
[45] Neter J, W Wasserman, MH Kutner. 1990. Applied linear statistical models: regression, analysis of variance, and experimental designs. 3rd ed. Burr Ridge (IL): Irwin. p. 101.

distribution of predators (particularly coyotes and ravens) at the proposed translocation and control sites will have a significant outcome on the monitored tortoises. As a result, the Translocation Plan must include an evaluation of predator populations at the proposed sites. If predator populations are not evaluated before translocations begin, there is substantial evidence to presume the translocated tortoises will succumb to the same fate as those in the Fort Irwin effort (i.e., > 40% killed by predators within 18 months).

The Applicant proposes to translocate some of the tortoises on the Project site to the "Northern Linkage Area" at the base of the Cady Mountains. This constitutes the preferred natural habitat for coyotes in the Mojave Desert (personal communication with Dr. Kristin Berry of the USGS, 6 Aug 2010). In addition, numerous herptile predators are known to have elevated densities near habitat edges caused by human development. This is precisely the area where the area proposes to deposit short-distance translocatees.

L. CONTROL SITES

The Translocation Plan specifically states "[r]ecipient areas and control animal areas are *key elements* of this plan."[46] It additionally states "[a] control animal would be designated for each translocated DETO for monitoring purposes", and that "[a] control animal is defined as one that is greater than 10 km from the translocated and designated resident animal."[47]

The Applicant does not appear to understand what a "control" treatment is, or how it is applied to scientific study. A control treatment consists of applying the identical procedures to experimental units that are used with the other treatments, except for the effects under investigation.[48] In this case, the Applicant has stated the purpose of the control site is to "check for homing activity and to observe translocated and resident DETO survivorship, compared to control animals."[49] Therefore, to examine the effects of the translocation, all other factors that affect tortoise movement (or homing) and survivorship must be identical.

The Translocation Plan's description of the control site is limited to the following:

> The control sites to the northwest of the site (Figures 6 and 9) were also surveyed in Spring 2010, and show varying levels of grazing, with some areas nearly denuded of vegetation. DETO were still found in these areas, and are likely to have historically occupied these areas in greater numbers, but grazing has reduced the cover, diversity, and size of vegetation in some areas minimizing available resources. Based on the areas where DETO were found onsite and off, it appears that DETO favored topographically diverse habitat consisting of small braided washes alternating with small inter-wash areas of upland. DETO found in the surveyed areas seem to be nearest to the foothills, close to the edges of the survey areas (areas that were greater than 20% slope were excluded from surveys). Additionally, the bulk of the disturbed areas appeared to have been historically good DETO habitat at some point in the past, but have since been denuded of vegetation. These areas are slowly returning to a natural state and could easily support more DETO

[46] Desert Tortoise Translocation Plan, Ex. 93, p. 2-1. [emphasis added]
[47] Desert Tortoise Translocation Plan, Ex. 93, p. 2-2.
[48] Neter J, W Wasserman, MH Kutner. 1990. Applied linear statistical models: regression, analysis of variance, and experimental designs. 3rd ed. Burr Ridge (IL): Irwin. p. 526.
[49] Desert Tortoise Translocation Plan, Ex. 93, p. 2-23.

than they currently do if the habitat quality was improved.[50]

Using this information and other information provided in the Translocation Plan, I generated a table to compare how closely the Applicant's control treatment replicated the experimental setting of the other treatments (Table 1).[51] The variables listed in the table have been identified by desert tortoise researchers as some of the factors that may influence desert tortoise movement and survivorship.

[50] Desert Tortoise Translocation Plan, Ex. 93, p. 2-4.
[51] *Id.*

Table 1. Site characterization variables of Applicant's proposed treatment units.[a]

	Linkage area	Pisgah ACEC	DWMA 1	DWMA 2 (southern)	DWMA 2 (northern)	Control
Purpose	Short-distance	Short and long-distance	Long-distance	Long-distance	Long-distance	Control
Vegetation type	Creosote Bush Scrub and Desert Wash Scrub	Mojave Creosote Scrub	Mojave Creosote Scrub	not provided	similar to Project site	not provided
Vegetation cover	dense wildflowers	not provided; forage "plentiful"	not provided	sparse	not provided	Some areas nearly denuded
Topography	transition zone; some steep rocky slopes	fairly flat	gently sloping	extremely hilly; canyon washes	"similar to Project site"	not provided
Substrate	gravelly to rocky	cobbles with small rock; sandy loam	gravelly; large boulders and cobbles	desert pavement; cobble and gravel	alluvial fan/bajada	not provided
Habitat quality	mapped as high	low and medium	high	low/medium	high	mapped as low/medium/high
DT density	not provided	not provided	not provided	not provided	not provided	not provided
Disease	unknown	unknown	unknown	unknown	unknown	unknown
Disturbance	little to none	past grazing; does not "appear fragmented" by road and transmission line	little sign	mostly pristine	not provided	Grazing has minimized available resources in some areas
Predator density	unknown	unknown	unknown	unknown	unknown	unknown
Exotic species	Little to none	small isolated patches of Sahara mustard	not abundant	not abundant	not provided	not provided
Other		Lower than expected DT activity	Inordinate number of carcasses (die-off)	Little DT activity	Inordinate number of carcasses (die-off)	DT activity found near edges

[a] The table was populated with information provided in the Applicant's Translocation Plan, and do not necessarily coincide with my professional opinion.

Even with the limited information provided by the Applicant, it's clear that the Applicant's experimental design is fatally flawed, and that is cannot be used to assess the success of the translocation effort. My conclusion is supported by the following reasons:

1. The control site is significantly different from the other treatment sites. As a result, it violates the critical assumption that the experimental unit (i.e., tortoise population) is subject to the same variables (e.g., predation levels, nutrient availability, disturbance level, foraging conditions, substrates) as the variable under investigation (i.e., translocation).
2. The Applicant has not provided any information on the statistical procedures it will employ to assess the effects of the translocation. However, the presence of numerous confounding variables and limited number of experimental treatments (e.g., only one control site) preclude the ability to test the "translocation effect."
3. Heightened predation pressure is considered a significant threat to desert tortoise populations. Predation by coyotes has been implicated as the primary cause of mortality for tortoises in the Fort Irwin study. Several studies have demonstrated elevated predator populations near anthropogenic disturbance. Agricultural fields provide supplemental food and water for coyotes and common ravens, which are the two primary predators of desert tortoises. The Applicant's proposed control area and long-distance translocation area "DWMA-1" are located relatively near the agricultural fields in the Newberry Springs area.[52] These agricultural fields are known to support elevated predator populations (personal communication with Dr. Kristin Berry of the USGS, 6 Aug 2010), which will confound the Applicant's ability to identify predation caused by the translocation effort.
4. The Translocation Plan states "A control animal would be designated for each translocated DETO for monitoring purposes."[53] The Applicant has not provided information on the number of tortoises occupying the control area. However, based on the limited information provided in the Translocation Plan, it does not appear the control area has enough tortoises to satisfy the Applicant's sample size.

Bjurlin and Bissonette (2004) found that the regular presence of researchers may facilitate predator detection of desert tortoises, and that systematic studies should be undertaken to better understand predator behavior as it relates to research activities. Given the numerous flaws outlined above, it's my professional opinion that by manipulating tortoises in the control area, the Applicant's current proposal would only subject tortoises to elevated predation pressure without providing any scientific value.

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[52] Agricultural fields can be seen in the background of Applicant's "photograph #4" provided in response to Sierra Clubs' 10 Aug 2010 data request.
[53] Desert Tortoise Translocation Plan, Ex. 93, p. 2-2.

M. QUARANTINE PENS

The Applicant proposes clearance surveys for Phase 1 in October 2010.[54] Each tortoise needing to be moved more than 500 meters would be placed in a quarantine pen. After the blood sample analysis is complete, healthy tortoises would be released from their quarantine pens by removing the exclusionary fence, thus allowing the tortoise to move freely within the translocation area.[55] The Translocation Plan lacks the information needed to evaluate the environmental impacts associated with the proposed quarantine actions for the following reasons.

First, the Applicant proposes to construct eleven 20m by 20m quarantine pens within the Pisgah ACEC.[56] However, the Applicant has not specified where the pens would be located within the ACEC, including their distribution and proximity to roads or other features that might hinder tortoise survivorship. Pisgah Road goes through the ACEC. If pens are located near this or other roads, tortoises would be subject to poaching—a known threat to desert tortoise populations. The pens would also have an increased probability of being vandalized, such that tortoises are released. Pens located near roads or the Project site would be susceptible to toxins and fugitive dust, both of which are likely to reduce survivorship. If the pens are not appropriately distributed across the landscape, tortoises that are allowed to exit the pens (once they are deemed healthy) would result in a density that exceeds the Applicant's established threshold. Conversely, if the pens are not located near an existing road, the Applicant must provide information on how it will transport construction materials, and a strategy for the frequent access that will be required for maintenance and monitoring during the quarantine period.

Second, the Pisgah ACEC is known to support several sensitive species, including white-margined beardtongue, Mojave fringe-toed lizard, crucifixion thorn, and sand linanthus.[57] The Applicant's Translocation Plan provides no discussion of how construction and use of quarantine pens in the ACEC might affect these sensitive species.

Third, the Applicant has provided no information on how it will minimize predation of tortoises once it removes the exclusionary fence from the pens. The Head Starting Program at Edwards Air Force Base implemented a strategy similar to the one proposed by the Applicant. Desert tortoises were raised in predator exclusion pens. Once they were released from the pens predators killed all of them.[58] The research team concluded the pens had become an attractive site for predators.[59] It is reasonable to assume similar results would

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[54] Desert Tortoise Translocation Plan, Ex. 93, p. 2-9.
[55] Desert Tortoise Translocation Plan, Ex. 93, p. 2-11.
[56] Desert Tortoise Translocation Plan, Ex. 93, p. 2-9.
[57] *See* Supplemental Staff Assessment, p. C.2-15.
[58] Bruno AL, M Hagan, KA Nagy, LS Hillard, RW Murphy. 2008. Desert Tortoise Hatchery Program at Edwards AFB; An Overview and Update on Program Success [Abstract]. Thirty-third Annual Meeting and Symposium; 2008 Feb 22-25, Las Vegas. The Desert Tortoise Council. Available from: http://www.deserttortoise.org/symposia.html.
[59] *Id.*

occur at the proposed quarantine pens, especially if they are located near the Project site or roads, which further attract predators.

Fourth, the Applicant has not provided any information on the materials that would be used to construct the quarantine pens. Netting was used to cover the pens at the Fort Irwin Study Site. During monitoring, biologists discovered that two of the pens (Pens 2 and 3) had sustained damage during a high wind event, which created several gaps and holes in the netting. Searches of the pens revealed 12 dead juvenile tortoises, all with their heads missing.[60] There were no live tortoises left; however, biologists reported two live ravens circling overhead, a third raven dead inside one of the pens, and the presence of several predatory lizards.

Fifth, the Applicant has not indicated how it will prevent contact of diseased tortoises within the pens with tortoises on the outside of the pens. This is a critical issue that must be resolved in a final plan.

Sixth, the Translocation Plan states "[a]n Authorized Biologist or Desert Tortoise Monitor shall check the pen at least daily and ensure that the DETO is in the burrow or pen, the DETO is being cared for in compliance with **the** animal husbandry plan developed by the vet, and the pen is intact. According to the guidelines set forth by the agencies, DETO cannot be held within a holding pen for more than one year. In addition, all quarantine facilities and animal husbandry plans would be developed by a qualified veterinarian and approved by the DTRO [federal Desert Tortoise Recovery Office]." However, the Translocation Plan does not indicate who would be caring for the tortoises; it does not provide an animal husbandry plan; and it does not identify the veterinarian that would develop the plan and quarantine facilities. Nonetheless, the Translocation Plan indicates the Applicant plans to start moving tortoises to quarantine pens in approximately six to eight weeks (October 2010).

N. MONITORING

The Applicant attempted to design a monitoring system for all translocated, resident and control tortoises to evaluate the success of the mitigation efforts. The Plan proposed daily monitoring of each individual tortoise for the first week, and every three to four days for the following two weeks. However, the Applicant did not adequately address the challenges of desert tortoise monitoring that has severely hampered previous translocation studies. Transmitters become detached, stop working, are broken by predators. Desert tortoise disperse over many miles.[61] In a study conducted for the Ft. Irwin Translocation Plan's 2009 Annual Report, 17.4% of transmittered desert tortoise subjects went missing.[62] In another

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[60] Everly CA. 2009 Apr 2. Memorandum for Desert Tortoise Recovery Coordinator, USFWS Desert Tortoise Recovery Office, 1340 Financial Blvd., Suite 234, Reno, Nevada 89502. Subject: Fort Irwin FISS Depredation.

[61] Hinderle, Danna and Boarman, William I. 2009. Desert Tortoise Homing Behavior Research Activities in Support of the Ft. Irwin NTC Expansion Project. US Fish and Wildlife Service.

[62] Berry, Kristin H. and Gowan, Timothy. 2009. The Health Status of Translocated Desert Tortoises (*Gopherus agassizii*) in the Ft. Irwin Translocation Area and Surrounding Release Plots, San Bernadino County, Year 2. USGS.

study within the Ft. Irwin 2009 Annual Report, 34% of transmittered desert tortoises were reported as "missing" or "location unknown", which even included 21 individuals that had not lost their transmitter.[63]

The Applicant has not taken any measures to avoid these documented pitfalls. On the contrary, the Revised Plan advocates for the use of the same transmitter and attachment methods as those employed in the previous studies. It even states that duct tape may be used to attach a transmitter temporarily if time constraints or temperatures prevent following the official protocol.[64] This is unacceptable. Furthermore, the Revised Plan does not include any threshold for the number of missing tortoises that will trigger remedial action. The Revised Plan does not specify how long field researchers will spend looking for missing desert tortoises during the strict monitoring schedule, how long after a missing individual cannot be found will it be considered dead and how many missing tortoises is acceptable before participating agencies require remedial steps. In addition, the Revised Plan states that desert tortoise monitoring will take place for "at least five years" but did not include the factors that will influence this time frame.[65] A rigorous and robust monitoring protocol must define minimum thresholds that will trigger a mitigation response in the event of unforeseen consequences. This monitoring plan fails to establish these necessary limits.

O. DISEASE TESTING

The prevalence of contagious disease within Mojave populations of the desert tortoise has been widely documented throughout agency literature and by the scientific community as a threat to wild populations and a key consideration in conservation initiatives.[66] Specifically, translocation activities pose risks due to the potential exposure of healthy populations to disease carriers. However, previous research indicates that reliable testing methodology does not exist for all the major desert tortoise diseases and improvements are constantly being developed.[67] The Ft. Irwin Translocation Plan has therefore developed a detailed decision tree framework when testing for transmissible diseases that includes rigorous assessments of any clinical symptoms, a full battery of disease testing for every desert tortoise and re-testing at six-week intervals in the case of suspect or positive test results until the health of the

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[63] Berry, Kristin H. and Gowan, Timothy. 2009. Health Status of Desert Tortoises (*Gopherus agassizii*) Remaining within Ft. Irwin's Southern Expansion Area in 2009: Recommendations for Disposition. USGS.

[64] URS Project No. 27658189.20002. 2010. Revised Draft Desert Tortoise Translocation Plan Calico Solar Project. San Diego. p. 2.10.

[65] *Id.* at p. 1-3.

[66] U.S. Fish and Wildlife Service. 2008. Draft revised recovery plan for the Mojave population of the desert tortoise (*Gopherus agassizii*). U.S. Fish and Wildlife Service, California and Nevada Region, Sacramento, California. 209 pp.; Christopher, Mary M., Berry, Kristin H., Henen, Brian T. and Nagy, Kenneth A. 2003. Clinical Disease and Laboratory Abnormalities in Free-Ranging Desert Tortoises in California (1990-1995). *Journal of Wildlife Diseases* 39(1), pp. 35-56.; Field, Kimberleigh J., Tracy, C. Richard, Medica, Philip A., Marlow, Ronald W., Corn, Paul Stephen. 2007. Return to the Wild: Translocation as a Tool in Conservation of the Desert Tortoise (*Gopherus agassizii*). *Biological Conservation* 136, pp. 232-245.

[67] Esque, Todd C., Nussear, Kenneth C., Drake, K. Kristina, Berry, Kristin H., Medica, Philip A., Heaton, Jill S. 2009. Amendment to Desert Tortoise Translocation Plan for Ft. Irwin's Land Expansion Program at the U.S. Army NTC and Ft. Irwin.

tortoise has been accurately verified.[68] Additionally, "healthy" has been strictly defined as a) lacking clinical signs of infection and b) either; negative test results to both *Mycoplasma spp* and herpes, or in case of a positive *Mycoplasma spp* result, an acceptable Western Blot test and PCR.[69] The Ft. Irwin methodology has become the acceptable standard that must be followed in concurrent and future translocation projects.

In comparison, the Translocation Plan proposed a much less rigorous testing protocol that does not adequately safeguard translocatees or resident tortoises from increased infection risk. According to the Plan, "in an effort to avoid infecting resident populations, as well as healthy DETO to be moved, a visual health assessment would be completed on all translocated DETO, as well as on the resident populations within the recipient sites."[70] Most importantly, the Plan does not even clarify which diseases are specifically of concern and being tested for. Upper Respiratory Tract Disease (URTD) is mentioned throughout the Plan, yet it makes no reference to shell necrosis, herpesvirus or any other "debilitating diseases" that are part of the Ft. Irwin testing protocol.[71]

Secondly, as described in the section regarding recipient site survey quality, the visual health assessments conducted by field staff were not acceptable. A full 63% of the data sheets for encountered live desert tortoises in DWMA 1 either had blank health sections or the surveyors wrote "unknown". Other qualitative assessments used include, "looks healthy" and "appears healthy" without any established guidelines as to what these labels mean or the actual assessment completed to determine health status. Visual health assessment procedures can be fairly in-depth and technical. Protocol for the Ft. Irwin Plan included identifying eroded nares, "crusts and dried mucus on the palpebrae, periocular area, fornix and beak" as a few signs of URTD infection. Plaques on the tongue, palate and other parts of the mouth are common clinical signs of herpesvirus infection.[72] Here the field survey forms omitted any rigorous protocol for their poor quality visual health assessments. There was none of the required proper training or certification normally granted to field staff in charge of conducting these visual health assessments, as these must be completed by professionals who have collaborated with qualified veterinary scientists in the case of Ft. Irwin. This calls into question the validity of the surveys.

Visual health assessments, while helpful in identifying a range of tortoise ailments when conducted properly, cannot be used as the only method of determining recipient site suitability. The Plan admits that URTD infection does not always manifest in visual clinical symptoms.[73] Scientists implementing the Ft. Irwin Plan verified this statement: "Tortoises can have subclinical disease or latent infections. They may have no clinical signs and be shedding bacteria or viruses (Schumacher et al 1997, Ritchie 2006, Martels et al. 2009). For example, the ELISA test for M. agassizii also detected potential subclinical infections in 34%

[68] *Id.* at p. 26.
[69] *Id.* at p. 5.
[70] URS, p. 2-11.
[71] Amendment to Ft. Irwin, p. 5.
[72] *Id.* at p. 22.
[73] URS, p. 2-11.

of tortoises without clinical signs of disease (but see Hunter et al. 2008)."[74] However, sites within the Ord-Rodman DWMA have already been listed as eligible recipient locations without conducting the necessary full health assessment, including blood and tissue samples of all resident tortoises. Disease prevalence and large die-off events have been observed throughout the Ord-Rodman DWMA (personal communication with Dr. Kristin Berry of the USGS, 6 Aug 2010). Consequently, a comprehensive health survey of all resident tortoises must be conducted *prior* to designating these areas as eligible recipient sites.

To further weaken the Plan's disease testing methodology, the Applicant states that tortoises translocated to sites less than 500 meters from their point of capture will not undergo blood and tissue testing, nor will resident tortoises in these "short-distance" recipient areas.[75] The Applicant fails to give any rational for this decision, which is in contradiction to both the Ft. Irwin Translocation Plan protocol as well as the guidelines set for in the USFWS Desert Tortoise Recovery Plan. According to the Amended Ft. Irwin Plan, all desert tortoises will undergo an in-depth visual health assessment as well as the full battery of laboratory tests, including ELISA tests, Western Blot tests and the appropriate tests for the presence of herpesvirus.[76] Guideline 6 of the Desert Tortoise Recovery Plan Appendix 1 (Guidance on Translocations) specifically states, "*All* potential translocatees should be medically evaluated in terms of general health and indications of disease, using the latest available technology, before they are moved."[77] Short-distance testing is only considered unnecessary in relation to genotyping translocatees. "All translocatees should be genotyped unless the desert tortoises are to be moved only very short distances or between populations that are clearly "genetically" homogeneous."[78] Therefore, this Plan does not follow the established agency recommendations for the recovery of this federal- and state-listed species and poses serious potential risk in terms of facilitating disease transmission during translocation activities. The Plan must be revised to reflect such recommendations.

In the event of identifying a diseased potential translocatee during Project site clearance surveys, the Applicant proposes to remove it first, to quarantine pens for an unspecified amount of time before being relocated to a currently undetermined location. "Diseased or seropositive DETO would remain in the quarantine pens until they can be removed from the field and taken to an appropriate facility approved by the DTRO and CDFG."[79] Aside from removing diseased tortoises, to this facility, the Plan did not provide for the probable fate of diseased tortoises, whether this includes veterinary treatment and recovery, participating in captive breeding programs or being euthanized and necropsied for research purposes. Various desert tortoise researchers have concluded even diseased animals can contribute to

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[74] Amendment to Ft. Irwin, p. 22.
[75] URS, p. 2-11.
[76] Amendment to Ft. Irwin, p. 23.
[77] US Fish and Wildlife Service. 1994. Desert Tortoise Recovery Plan as cited in Esque, Todd C., Nussear, Kenneth E., Medica, Philip A. 2005. Desert Tortoise Translocation Plan for Ft. Irwin's Land Expansion Program at the U.S. Army NTC and Ft. Irwin. p. 57.
[78] *Id.*
[79] URS, p. 2-11.

the population under carefully controlled circumstances, which is discussed as a viable option in Ft. Irwin translocation projects.[80] This must be clarified.

In the event of identifying a diseased resident tortoise in an eligible recipient site, the Applicant proposes establishing a 2.5 km buffer around the individual that will be off-limits to translocation. Yet the rational for this size of buffer has not been included in the Plan, and so remains arbitrary. In comparison, Ft. Irwin researchers determined that a 5 km buffer is appropriate. The Ft. Irwin scientists also included their rational: "If a sampling location containing diseased resident animals (including suspect laboratory test results) is detected during disease sampling in the WETA, then a 5 km buffer will be placed around the diseased animal(s). Translocated tortoises will not be released within this 5 km buffer. Buffer size was determined by an analysis of the spatial distribution of disease found in the SEA (Fig 3)."[81] Since the applicant has not conducted a comprehensive spatial disease analysis in any of the eligible translocation sites, the Applicant could not have accurately determined an appropriate buffer size to prevent disease transmission to relocated desert tortoises. This must be rectified for the Plan to be adequate.

Miscellaneous Issues

1. In discussing the proposed Pisgah ACEC translocation site, the Applicant's Translocation Plan reported "[t]he soft soils and lack of topographic variety (washes) likely contributed to lower than expected DT activity. The northern portion of this area is medium quality DT habitat, while the southern portion is low quality."[82] Tortoises translocated off the Project site into lower quality habitat are unlikely to survive especially when considering the numerous adverse effects inherent with handling, moving, and displacing tortoises (e.g., elevated stress and heightened predation).
2. The Translocation Plan states "A total of 10 adult and 2 subadult DETO and 70 burrows (Categories 1-4) were observed in this area [proposed Pisgah ACEC translocation site] during protocol surveys (Figure 7)." Figure 7 does not depict burrows in the Pisgah ACEC, and the Translocation Plan does not provide any data on burrows in the Pisgah ACEC. By providing total number of burrows in categories 1-4 for the proposed translocation areas, but only categories 1-3 for the Project site, the Applicant has artificially inflated burrow density at the translocation sites in relation to the Project site.[83]
3. Desert tortoises (or tortoise sign) were not detected throughout most of the proposed Pisgah ACEC translocation site.[84] Applying the Applicant's own criteria that the

[80] Amendment to Ft. Irwin, p. 24.
[81] *Id.* at p. 9.
[82] p. 2-3 and 2-4.
[83] URS. 2010 May 17. Results of 2010 Desert Tortoise 10m Transect Survey for Calico Solar Project. p. 2.
[84] *See* Figures 6 through 9 of Applicant's Revised Biological Assessment.

presence of DETO and DETO sign demonstrate habitat quality, most of the habitat with the Applicant's proposed translocation site is considered poor.[85]

4. According to the Translocation Plan, "the habitat in the northern DETO linkage was surveyed as part of the 1,000 foot buffer of the original Project boundary and is located in the transition zones between the foothills and flatter alluvial valleys but also includes steep rocky slopes at the edge of the Cady Mountains. This area was comprised of creosote bush scrub and desert wash scrub."[86] This information appears to contradict the AFC, which mapped some of the linkage area as "unvegetated", and which did not identify any desert wash scrub habitat in the Project Assessment Area.[87] This discrepancy must be rectified.

5. The Translocation Plan states "[b]ased on agency input, the density of the recipient site after translocation should not exceed 130 percent of the known density within the recovery unit, which was determined to be 4.7 DETO per square km (12.2 per square mile)."[88] The Applicant provides no information to substantiate the density estimate of 4.7, including the methods used to generate the estimate, the year associated with the estimate, and whether the value represents a mean, median, or maximum. Application of a generalized estimate ignores the patchy distribution of tortoises and their habitat across the geographic range (and the recovery unit). Nonetheless, the Applicant has elected not to use <u>actual</u> density estimates for the translocation sites (based on its recent field surveys). This error must be rectified.

6. The Translocation Plan assumes the proposed recipient areas have good quality habitat and are at the **known limit** of 4.7 tortoises/square km.[89] Yet, it states "2 DETO per square km (five per square mile) would be allowed to be translocated into them."[90] It's scientific fact that when additional individuals are added to a population at its "known limit" there will be either (a) compensatory mortality; or more likely (b) the entire population will crash.[91]

7. The Applicant has indicated "[a] lead biologist experienced in DETO ecology and conservation would orchestrate this [translocation] program and be the main point of contact for the agencies, Applicant, and participating biologists."[92] The Fort Irwin translocation plan was led by several experienced desert tortoise researchers that arguably are considered among the top in their field of study. Although the Applicant's proposed translocation of tortoises from the Project would be imminent, the Applicant has not yet identified the lead biologist responsible for the proposed translocation program. Throughout, the Applicant has tended to rely on inexperienced and unqualified field personnel, including many of the desert tortoise

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[85] p. 2-2.
[86] p. 2-4.
[87] AFC, Figure 5.6-2.
[88] p. 2-4.
[89] p. 2-4.
[90] p. 2-4.
[91] Meffe GK, CR Carroll. 1997. Principles of Conservation Biology, 2nd edition. Sinauer Associates, Inc., Sunderland, MA.
[92] p. 2-5.

surveyors that have been used for the Project. Only highly experienced and skilled desert tortoise experts can implement a translocation plan given the high quality of the resident desert tortoise population at the project site and the value of the site as habitat.

8. Past translocation projects have demonstrated that holes in exclusionary fencing may lead to tortoise mortality. The Translocation Plan states tortoise exclusion fencing would be inspected within 24 hours following all major rainfall events, which it defines as one for which flow is detectable within the fenced drainage.[93] The Translocation Plan does not specify who would be responsible for detecting flow, or how personnel would be able to detect flow across a 6,215-acre site given the tendency for highly localized rain events in the Mojave Desert. Furthermore, the numerous retention basins within the northern Project boundary would temper flows on the Project site, but would not alter the effects flows emanating from the Cady Mountains might have on the exclusion fence (which would be the fence preventing tortoises translocated to the linkage area from returning to their home range).

9. The tragic failures at Fort Irwin show that monitoring tortoises is extremely difficult. A common issue has been locating the tortoises after their release. Transmitters often fall off or stop working. In one study, over 1/3rd of the tortoises (33 of 96) could not be found.[94] In another study, the locations of 41.1% of monitored tortoises were "unknown."[95] The only information provided in the Applicant's Translocation Plan is that it would attach radio transmitters "according to established methods (Boarman et al. 1998)" and that transmitters "might be temporarily attached with duct tape if temperature or time constraints would not allow for proper transmitter attachment."[96] There is no indication that these techniques would resolve the problems experienced by Fort Irwin and are emphatically not acceptable here given the known problems associated with accurate monitoring.

10. According to the Translocation Plan "spatial distribution of DETO within the recipient site is important and must be considered when determining specific locations."[97] However, the Translocation Plan does not identify the specific locations where tortoises would be deposited.

11. Following release, the Applicant proposes to monitor each translocated tortoise to ensure that it is acclimating normally and has found adequate shelter.[98] The Translocation Plan does not specify the duration of monitoring (i.e., minutes or hours), nor does it indicate what remedial actions would be taken if a tortoise has not acclimated or found a shelter.

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93 p. 2-8.
94 Fort Irwin Annual Monitoring Report. 2009. Appendix 1.
95 Fort Irwin Annual Monitoring Report. 2009. Appendix 5.
96 p. 2-10.
97 p. 2-12.
98 p. 2-12.

12. According to the Translocation Plan "[I]f vegetation is not adequate in the holding pens, the tortoise might require supplemental feeding and hydration."[99] However, the Translocation Plan does not identify how it would determine whether a tortoise might require supplemental feeding and hydration.

13. The Translocation Plan indicates up to 185 tortoises may require translocation and that a total of 50 square km have been identified as potentially suitable translocation sites.[100] Even if every square km is disease free and suitable for translocation, and assuming each square km can be augmented with one to two additional tortoises (as established by the Applicant), the Translocation Plan has identified suitable release sites for less than 100 of the possible 185 tortoises requiring translocation.

14. The Translocation Plan states "[p]ortions or ***all*** of the recipient area might be ruled out for short-distance translocation for various reasons. Potential reasons might include the following: 1) the habitat is of insufficient quality or lacks enough similarity as compared to the habitat where the DETO are being translocated from; 2) the resident DETO population within the recipient areas is determined to be too dense (or at carrying capacity) and introduction of translocated individuals would compromise translocated individuals, the resident population, and/or both; and 3) diseased individuals are detected within the resident population."[101] The Applicant has had several years to collect data on these factors; they are essential to a successful translocation effort and they must be established *before* a draft translocation plan is even considered by the wildlife agencies and the public.

15. According to the Translocation Plan, "[t]he occurrence of health-compromised DETO is estimated to be approximately three to five percent of the population (AMEC 2008)."[102] The Applicant has misrepresented the effect disease has on desert tortoise populations. The reference cited by the Applicant actually states "[t]he current rate of infection in wild tortoise populations throughout the western Mojave Desert is unknown, but has been observed to be approximately 3-5 % in three sites located several miles northwest of the [Victorville] site (A. Karl, field notes)."[103] Field notes from three sites near Victorville can hardly be considered a reliable estimate of the percentage of health-compromised tortoises throughout the Mojave Desert. On the contrary, research has shown that diseased desert tortoises occur in "pockets", and that disease (or other illnesses) differentially afflicts local populations (i.e., some populations experience complete die-offs, whereas others are barely affected).[104] The Ord-Rodman DWMA is known to have diseased tortoises (personal communication

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[99] p. 2-13.
[100] p. 2-15 and Figure 5.
[101] p. 2-16 (emphasis added).
[102] p. 2-16.
[103] AMEC. 2008. *Victorville 2 Hybrid Power Project Desert Tortoise (*Gopherus agassizii*) Translocation Plan.* Prepared for: City of Victorville on behalf of Inland Energy and ENSR Corporation. May 2008. p. 13.
[104] Personal communication with Dr. Kristin Berry of the USGS, 6 Aug 2010. Also, *see* abstracts presented at 2008-2010 Desert Tortoise Council Symposia.

with Dr. Kristin Berry of the USGS, 6 Aug 2010). Further study and analyses are required before any plan can be finalized.

16. The Translocation Plan reports an "inordinate number of carcasses" all within the same relative age class of roughly two to four years, were detected in the long-distance translocation sites, but that disease does not appear to be the cause of death. The Applicant then concluded that the habitat is high quality and that several consecutive years of drought could be the cause of death.[105] However, if drought was the cause of death, one would expect to have observed a similar spike in mortality at the Project site across the same three year period of surveys (i.e., 2007-2010). A more reliable assessment of the apparent die-offs in the proposed translocation areas must be conducted before they are established as suitable translocation sites.

17. The Translocation Plan indicates a 2.5-km buffer zone (7.5 square mile) would be placed around diseased or seropositive DETO found within the recipient sites, and that no translocation would occur within this buffer zone.[106] The Translocation Plan has identified 39.8 square km (9,833 acres) within the proposed Ord-Rodman long-distance translocation area. The proposed translocation area already is not big enough to support all the tortoises the Applicant anticipates having to translocate. If even a few diseased tortoises are detected in the long-distance translocation area, it would no longer be a viable translocation site. This is a critical issue that must be resolved in a final plan.

[105] p. 2-19.
[106] p. 2-11.

Declaration of Scott Cashen
Calico Solar Project

Docket 08-AFC-13

I, Scott Cashen, declare as follows:

1) I am an independent biological resources consultant. I have been operating my own consulting business for the past three years. Prior to starting my own business I was the Senior Biologist for TSS Consultants.

2) I hold a Master's degree in Wildlife and Fisheries Science. My relevant professional qualifications and experience are set forth in the attached testimony and are incorporated herein by reference.

3) I prepared the testimony attached hereto and incorporated herein by reference, relating to the biological resource impacts of the Calico Solar Project.

4) I prepared the rebuttal testimony and maps attached hereto and incorporated herein by reference relating to the distribution of solar energy generation infrastructure in San Bernardino County.

5) It is my professional opinion that the attached rebuttal testimony and maps are true and accurate with respect to the issues that they address.

6) I am personally familiar with the facts and conclusions described within the attached testimony, and if called as a witness, I could testify competently thereto.

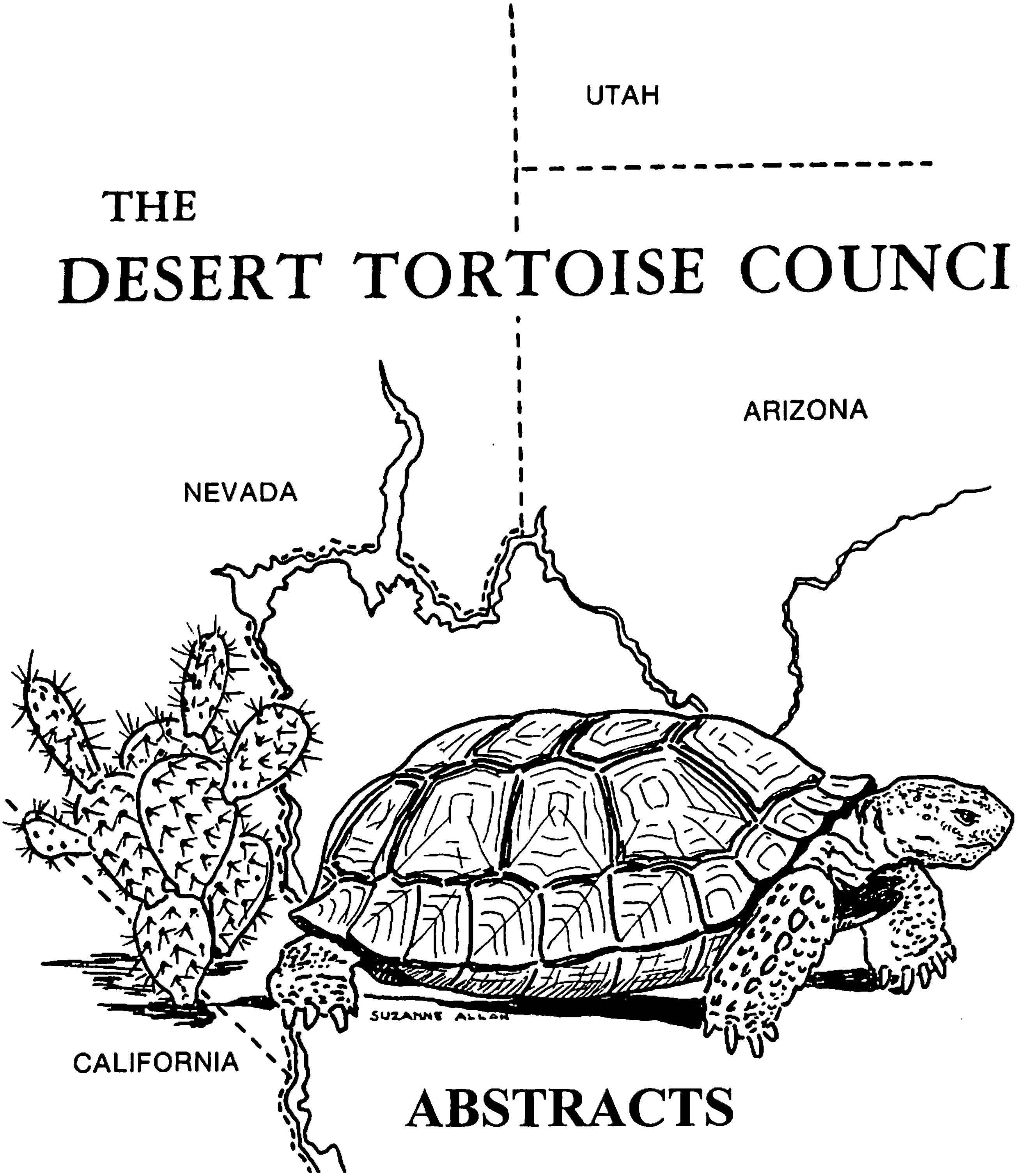
I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: 8-17-10 Signed: [signature]

At: Walnut Creek, CA

EXHIBIT 444

THE DESERT TORTOISE COUNCIL



ABSTRACTS

33rd Annual Meeting and Symposium

Sam's Town Hotel and Casino, Las Vegas, NV

February 22–25, 2008

however, the revised plan places a greater emphasis on solidifying partnerships across jurisdictional boundaries to maintain focus on implementation.

After internal regional review, the next step will be to submit a notice of availability to the Federal Register to commence the 60-day public comment period.

Decision Time for Desert Tortoises in the Fort Irwin Translocation Project: Health and Disease Issues

Kristin H. Berry[1], Jeremy Mack[1], Mary Brown[2], Kemp Anderson[3], John Roberts[2], and Elliott Jacobson[2]

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The Ft. Irwin Translocation Project (FITP) for desert tortoises (*Gopherus agassizii*) is in its third year of a multi-year effort. Between 2005 and 2007, we collected baseline data on health of tortoises in three groups: translocatees, affected residents, and controls with an emphasis on the translocatees. We have evaluated 943 tortoises, of which the majority were in the Southern Expansion Area (SEA) and may be translocated in 2008. As part of the total, 125 tortoises were in the stress research program managed by USGS colleagues Todd Esque, Ken Nussear, Phil Medica, and Kristina Drake, and 70 were juvenile or small immature tortoises, kept at the Ft. Irwin Study Site pens and lab. All tortoises were evaluated for general health and clinical signs of upper respiratory tract disease (URTD), shell diseases, and trauma). We drew blood samples for enzyme-linked immunoassays (ELISA) for two species of *Mycoplasma*, *M. agassizii* and *M. testudineum*, and took nasal lavages for cultures, polymerase chain reaction (PCR) tests, and DNA fingerprinting of pathogens from most subadult and adult tortoises, but from only 49 of the 70 juvenile and small immature tortoises. For the period 2005–2007, laboratory test results indicated that 28 subadult and adult tortoises tested positive or suspect for *M. agassizii* or *M. testudineum*. With three exceptions, these tortoises were in the western half of the study area, west of or in the vicinity of the Manix Trail or Fort Irwin Road in similar areas where tortoises had positive and suspect tests in 2005 and 2006. Tortoises that tested suspect or positive for *M. agassizii* ($n = 10$) were independently distributed ($X^2 = 2.68$, $p = 0.101$), whereas those that tested suspect or positive for *M. testudineum* ($n = 20$) were significantly distributed west of the Manix trail ($X^2 = 17.24$, $p < 0.001$). Fifty percent of tortoises with suspect or positive tests were located with a 2.5 km buffer of heavily used roads, i.e., Ft. Irwin Road, Manix Trail, Interstate 15, and the powerline road in the eastern half of the study area. One moribund tortoise with hind limb paralysis, fecal impaction, and hepatic atrophy was salvaged from the Minneola area in August 2007. Several juveniles have died. We plan on evaluating an additional 282 tortoises in spring: 132 previously unsampled or inadequately sampled tortoises, the 28 tortoises with previous suspect or positive *Mycoplasma* tests, and 122 tortoises living within 1 km of a suspect or positive tortoise. Prior to the translocation in early spring of 2008, several questions must be addressed, e.g., should healthy tortoises be moved into areas with ill tortoises?

Moving Day: Large-scale Translocation of Desert Tortoises at Fort Irwin, California

William I. Boarman[1], A. Peter Woodman[2], and Andrew Walde[3]

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The U.S. Army's plan to expand onto approximately 44,500 ha of desert tortoise habitat in the Central Mojave Desert precipitated the need to move an estimated 1200-2200 desert tortoises out of harm's way. The large number of animals affected resulted in a Biological Opinion that requires the Army to translocate these animals and fund research on the effects translocation may have on tortoise populations to help inform other translocation efforts that may occur in the future. We report here on the preliminary findings from initial surveys from the Southern Expansion Area (below the 90 grid line), an area that represents approximately 25% of the expansion area that contains desert tortoises. In addition, we present the proposed plans for the actual translocation of animals and for studying the effects the translocation may have on tortoise movements, dispersion, reproduction, population genetics, behavior, and demography. Furthermore, this broad, 200% survey will be used to assess actual tortoise abundance, landscape-scale habitat features, and genetic dispersion patterns. The unprecedented scale of this project promises to yield many interesting and valuable results.

Neither Here Nor There: Current Status of Sonoran Desert Tortoise Populations in Arizona

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The desert tortoise is listed as a threatened species in the Mojave Desert, but not in the Sonoran Desert of Arizona. To determine if 20 years of population data reveal declines sufficient to list the Sonoran population of the Desert Tortoise listing under the Endangered Species Act, we analyzed data collected from 16 study plots throughout tortoise range in Arizona. Using mark-recapture data, we estimated annual population levels using Lincoln-Peterson and Schnabel estimators and built linear models including plot, time, and year. We also compared abundance and trends among plots with different levels of threats (singly and grouped) and disease signs and different habitat types. The Sonoran population of the desert tortoise has experienced statistically significant declines of 3% per year between 1987 and 2007. This equates to an estimated 35% reduction in the number of adults and subadults on study plots since 1988. There were statistically significant declines in four study plots, and nearly significant in a fifth. Presence of specific diseases and threats did not help to explain trends in specific plots. Upper respiratory tract disease and cutaneous dyskeratosis, have been verified in Arizona tortoise populations. Some populations may suffer from isolation and demographic stochastic

Desert Tortoise Hatchery Program at Edwards AFB; An Overview and Update on Program Success

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The desert tortoise (*Gopherus agassizii*) Head Starting Program at Edwards Air Force Base, known as the Juvenile Hatchery at the Edwards Tortoise Study Site (JHETSS), began in 2002 as an adaptive management plan to test at what age desert tortoise hatchlings raised in predator exclusion pens can be released into the wild with an increased survival rate. The program was also developed to test if supplemental irrigation can accelerate achievement of predator resistant body size by increasing/prolonging food available in the pens. Over the course of the study, disease transfer from female tortoises to eggs, and paternity of JHETSS neonates was also investigated. The paternity test confirmed that at least 8 of the 11 clutches involved multiple paternities. Juveniles in irrigated pens have tripled in size compared to the juveniles in the nonirrigated pens. Before 2007, a total of 15 yearling desert tortoises were released near the JHETSS site. Predation as well as additional factors resulted in 100 percent mortality. In the fall of 2007, 32 yearlings were released, 16 near the JHETSS site and 16 at a distant location of similar habitat to test if the JHETSS pens are affecting survivorship of released yearlings. The JHETSS pens seem to have become attractive sites for predators, and may be having a negative effect on the tortoise survivorship. Concerns for the future of the study are that the adult females are threatened by increased off-road activity and feral dogs are becoming a common nuisance at the JHETSS site.

POSTER

Native Plant Revegetation of Drastically Disturbed Soils in the Mojave: Success on the Standard Hill Mine Gold/Silver Ore Heap, Mojave, CA

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[2]Shell Exploration & Production Company, Denver, CO; and [3]Summit Associates LLC, Boise, ID

The Standard Hill Mine was a cyanide heap-leach gold/silver mine near Mojave, CA, operated by a former Shell Oil Company subsidiary. Mining and leaching operations were carried out from 1987 to 1993. During operations, metal ores were extracted from crushed ore material on the heap by leaching with a re-circulating weak alkaline solution of sodium hydroxide and sodium cyanide. Fresh water rinsing of the ore heap (from 1993 to 1999) with varying amounts of sodium hypochlorite during closure activities removed cyanide, but left essentially a sterile, crushed gravel pile with no organic matter and a high sodium content.

In late spring 2003, Shell initiated a voluntary, no-irrigation native plant revegetation effort of the ore heap using a combination of broadcast seeding with mat-drag over dozer-tracked surface and hydroseeding of both mineral and essential organic soil amendments containing specific humic substances. The ore heap was re-contoured and seeded in two phases: half in 2003 and half in early spring 2004. No plant emergence occurred on the ore heap until late 2004, when all seeded areas began showing seedlings of saltbush shrubs and minor grasses. By spring 2005, saltbush shrubs, minor creosote, winterfat and peppergrass shrubs, and numerous forbs appeared, including forbs self-seeded from surrounding desert areas. Drought conditions and rabbit herbivory depredation have prevailed in the Mojave area since spring 2006, resulting in some die-off of shrubs on the ore heap, but the dominant native saltbush-shrub community appears to be self-sustaining. Three years of monitoring observations are presented in this poster.

Western Watersheds Project, Livestock Grazing, and the Desert Tortoise

Michael J. Connor, Ph.D., California Science Director, Western Watersheds Project

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Western Watersheds Project (WWP) works to protect and conserve the public lands, wildlife and natural resources of the American West through education, public policy initiatives and litigation. Since its inception, WWP has focused its efforts on promoting environmentally responsible livestock grazing on public lands. Recent actions by WWP have benefited desert tortoise conservation at both regional and site-specific levels.

In 2006, the Bureau of Land Management (BLM) promulgated major revisions to the grazing regulations that had been in effect since 1995. These industry-sponsored revisions removed restrictions on livestock grazing that promoted rangeland health, decreased monitoring, and decreased public participation in the grazing decision process. WWP sued in federal court over violations of NEPA, FLPMA and the ESA. In June 2007, the court ruled in WWP's favor and threw out the new regulations.

The 1994 Desert Tortoise Recovery Plan considered livestock grazing to be incompatible with desert tortoise recovery and recommended that it be prohibited in Desert Wildlife Management Areas (DWMA). Despite this, livestock grazing continues in key areas of desert tortoise habitat in California. The Ord Mountain Allotment is the largest livestock grazing allotment within desert tortoise critical habitat in BLM's West Mojave planning area and includes two thirds of all the tortoises that occur on grazing allotments in the region. The allotment covers 240 square miles of desert tortoise habitat and, according to the USFWS, has an estimated population of 3,347 adult tortoises. The allotment occupies about 45% of the entire Ord-Rodman DWMA. This DWMA includes most of the desert tortoise population of the recently defined "Southern Mojave Recovery Unit" (Murphy et al., 2007). In summer 2007, the BLM issued a decision to renew livestock grazing on the Ord Mountain Allotment at increased stocking levels for 10 years. Western Watersheds Project, Center for Biological Diversity, Sierra Club, Natural Resources Defense Council, and Desert Survivors appealed the decision. The Administrative Law Judge hearing the appeal agreed with the conservation groups and issued a stay, ordering the BLM to hold off on its decision to increase cattle grazing on the Ord Mountain Allotment pending a hearing now scheduled for July 2008. The stay was issued because the conservation groups demonstrated that the increase in cattle stocking was above the carrying capacity of the allotment. However, there are other significant livestock management issues on the allotment. The BLM's West Mojave Plan established a 59,368 acre "Designated Exclusion Area" on the Ord Mountain Allotment from which cattle are to be removed when ephemeral forage production is less than 230 pounds per acre. While ostensibly meant to protect the desert tortoise, the Designated Exclusion Area is erroneously located in poorer tortoise habitat on the allotment's east side and fully 41% of it is located outside the DWMA. Consequently, in drier years cattle are concentrated in higher tortoise density areas within the DWMA on the allotment's west side thus increasing impacts at a critical time and achieving the opposite of what was intended. WWP is working with the agencies to remedy this situation.

Report on U.S. Fish and Wildlife Service Activities for 2007 and 2008

Brian Croft

U.S. Fish and Wildlife Service, 2493 Portola Road, Suite B, Ventura, CA 93003

The U.S. Fish and Wildlife Service's (Service) responsibilities for the desert tortoise under the Federal Endangered Species Act (ESA) include recovery planning and implementation, section 7(a)(2) consultations with Federal agencies, issuance of recovery permits for research and monitoring, and review and development of habitat conservation plans for section 10(a)(1)(B) projects on private lands. This report focuses on completed, ongoing, and foreseeable consultations, habitat conservation plans, and recovery implementation activities within the range of the desert tortoise for 2007 and 2008.

An Update on Desert Tortoise Use of Burned Critical Habitat in Nevada

Kristina Drake, Lesley A. DeFalco, Kenneth E. Nussear, Todd C. Esque, Sara Scoles-Sciulla, and Philip A. Medica*

U.S. Geological Survey, Western Ecological Research Center, Henderson, NV

The Southern Nevada Fire Complex burned more than 32,000 acres of designated desert tortoise (*Gopherus agassizii*) critical habitat in 2005. In an effort to accelerate the recovery of plants important as food and cover for desert tortoises, the Bureau of Land Management (BLM) and US Geological Survey (USGS) established 40-acre monitoring plots (n=51) within this fire complex using multiple treatments (burned and seeded, burned with no treatment, and unburned). Although the immediate effect of fires on desert tortoise has been established, it is still unknown how and if tortoises use large burned areas after fires. The USGS initiated studies to understand habitat use for desert tortoises after those fires. In 2006 and 2007, the USGS conducted area surveys for tortoise presence and sign within each monitoring plot to determine if tortoises are responding to the seeding treatment within burned habitat two years after establishment. Radio transmitters were attached to 27 tortoises to investigate how the shift in the

Desert Tortoise (*Gopherus agassizii*) Micro-habitat Selection on the Florence Military Reservation, Pinal County, Arizona

David D. Grandmaison

Arizona Game and Fish Department, Research Branch, 5000 W. Carefree Highway, Phoenix, AZ 85086

Desert tortoise habitat on the Florence Military Reservation (FMR) in Pinal County, Arizona is considered atypical due to the lack of boulder strewn hillsides and the predominance of flat alluvial plains in the landscape. Tortoises utilize caliche caves associated with deeply incised washes and appear to concentrate their activity around the few rocky hillsides that occur on the installation. As a result, the location of desert tortoise home ranges on the installation is correlated with the availability of caliche caves. Hypotheses regarding micro-habitat selection for specific habitat components within desert tortoise home ranges (n = 14) were evaluated with a use-availability design under an information-theoretic framework. The results of this analysis indicate that desert tortoises selected areas within their home range that were characterized by a higher percentage of canopy cover, less cattle activity, and closer proximity to roads and washes than available within their home ranges on the FMR. Canopy cover had the highest calculated importance and was included in each of the supported models. Activities that reduce canopy cover on the FMR may not be compatible with maintaining high quality desert tortoise habitat. These results indicate that management prescriptions that maintain or increase the amount of vegetative cover on the installation will benefit desert tortoises and increase their likelihood for long-term persistence.

QuadState Local Governments Authority: A Partner in Desert Tortoise Recovery

Gerald Hillier, Executive Director

QuadState Local Governments Authority, P.O. Box 55820, Riverside, CA 92517

During past year, the organization changed its name reflecting the JPA, which has now existed for 9 years. The Authority's membership includes 7 of the 11 county governments embraced in the range of the Mojave Population.

The Authority has actively engaged in the tortoise recovery plan review and revision. It provided FWS comprehensive comments, of which I discuss three:

- Efficacy. The early drafts lack assessment what has been accomplished, and the outcome of the two major HCPs in the region. The FWS and agencies must seek to know what has actually brought about recovery, or why implementation and mitigation measures have failed.

- Flexibility and innovation. The drafts embrace "adaptive management," but lack specificity as to the use of experimental or new techniques, including intervention. The plan must allow going beyond the "approved" list. revision.

1. Solar project applications are not accepted within desert wildlife management areas or critical habitat of any listed species.
2. Solar project applications have recently been rejected from Mohave ground squirrel habitat conservation areas.
3. Solar applications are not accepted within flat-tailed horned lizard management areas.

All power plant proposals on federal lands will prepare environmental impact statements, and mixed jurisdiction projects will prepare a joint federal/state environmental document. Many of the solar projects are regulated by the California Energy Commission.

Transmission line upgrades are needed to carry power from these projects to the urban centers of southern California. Most projects are located near designated utility corridors. California reviews the transmission network at the state level through several agencies, particularly the California Public Utilities Commission. Proposals for new or upgraded transmission lines will also have public review via a federal and state Environmental Impact Statement/Environmental Impact Report.

The analysis of cumulative impacts to the desert environment from alternative energy projects and the transmission network will be the biggest challenge for the federal government's Department of the Interior, Department of Energy and Department of Defense.

Epidemiology of Upper Respiratory Tract Disease in Desert Tortoises At the Daggett Study Area, California, in 2007

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Between March and June of 2007, we established a research project near Daggett in western San Bernardino County, California, to study the epidemiology of mycoplasmosis caused by *Mycoplasma agassizii* and *M. testudineum* in desert tortoises (*Gopherus agassizii*). We fitted 80 adults (40 males, 40 females) with radio transmitters at a study area southeast of the town of Daggett. The study area has three bands (core, middle, outer) along a ~8 km transect, which extends southeast from the edge of Daggett and Interstate 40. Each band was established at an increasing distance from the urban-desert interface. We sampled the tortoises in spring and again in fall, drawing blood, nasal lavage samples, and evaluating clinical signs of disease using previously described protocols. In spring, we sampled an additional 35 tortoises without transmitters to fill gaps between the bands.

In the spring, nine tortoises tested positive or suspect for *M. agassizii* and ten tested positive or suspect for *M. testudineum*. In the fall, eight tortoises tested positive or suspect for

M. agassizii and seven tested positive or suspect for *M. testudineum*. Suspect or positive tortoises were not independently distributed among bands. Tortoises with *M. agassizii* showed evidence of clustering within the core (x^2_{spring} = 14.29; p < 0.01; x^2_{fall} = 23.93; p< 0.01), whereas tortoises with *M. testudineum* were slightly clustered in both the core and middle bands (x^2_{spring} = 6.54; p < 0.05; x^2_{fall} = 7.32; p < 0.05). Several tortoises had test results that varied between seasons. A group of tortoises (n = 9) also displayed clinical signs of disease, but had negative test results for both species of *Mycoplasma*.

Eight of the 80 tortoises with radiotransmitters have died and a ninth is probably dead (11.25%). Of the tortoises with transmitters, five were males and four were females. All showed signs of predation or scavenging or both. Several of the dead tortoises had previously tested suspect or positive for one or both types of *Mycoplasma*. We obtained blood and nasal lavage samples from seven of the nine tortoises before they died. Of these tortoises, two tested positive for both species of *Mycoplasma*, two tested positive for *M. agassizii* and suspect for *M. testudineum*, one tested suspect for *M. testudineum*, and two tested negative for both species. All seven tortoises displayed clinical signs of disease, including discharge from the nares, even those with suspect or negative tests. Six of the nine dead tortoises were clustered in the core area.

One marked adult male tortoise, previously sampled in 2005, was salvaged for necropsy in April of 2007. This tortoise had severe clinical signs of upper respiratory tract disease and a partially swollen head, but had tested negative for both species of *Mycoplasma*. When observed in spring of 2007, the same clinical signs were evident, weight had dropped, and condition was poor. Necropsy results indicated rhinitis, not typical of mycoplasmosis, but with a severe chondrodysplasia of the cartilage that supports the nasal mucosa. Changes in bone and cartilage were chronic and led to the collapse of the hard pallet, creating bilateral fistulas. The culture indicated *Pasteurella aerogenes*. Tortoises testing negative for *Mycoplasma* but with moderate to severe nasal discharge or occluded nares may have another disease.

Acknowledgements: We thank the National Training Center and Mickey Quillman at Ft. Irwin for funding.

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

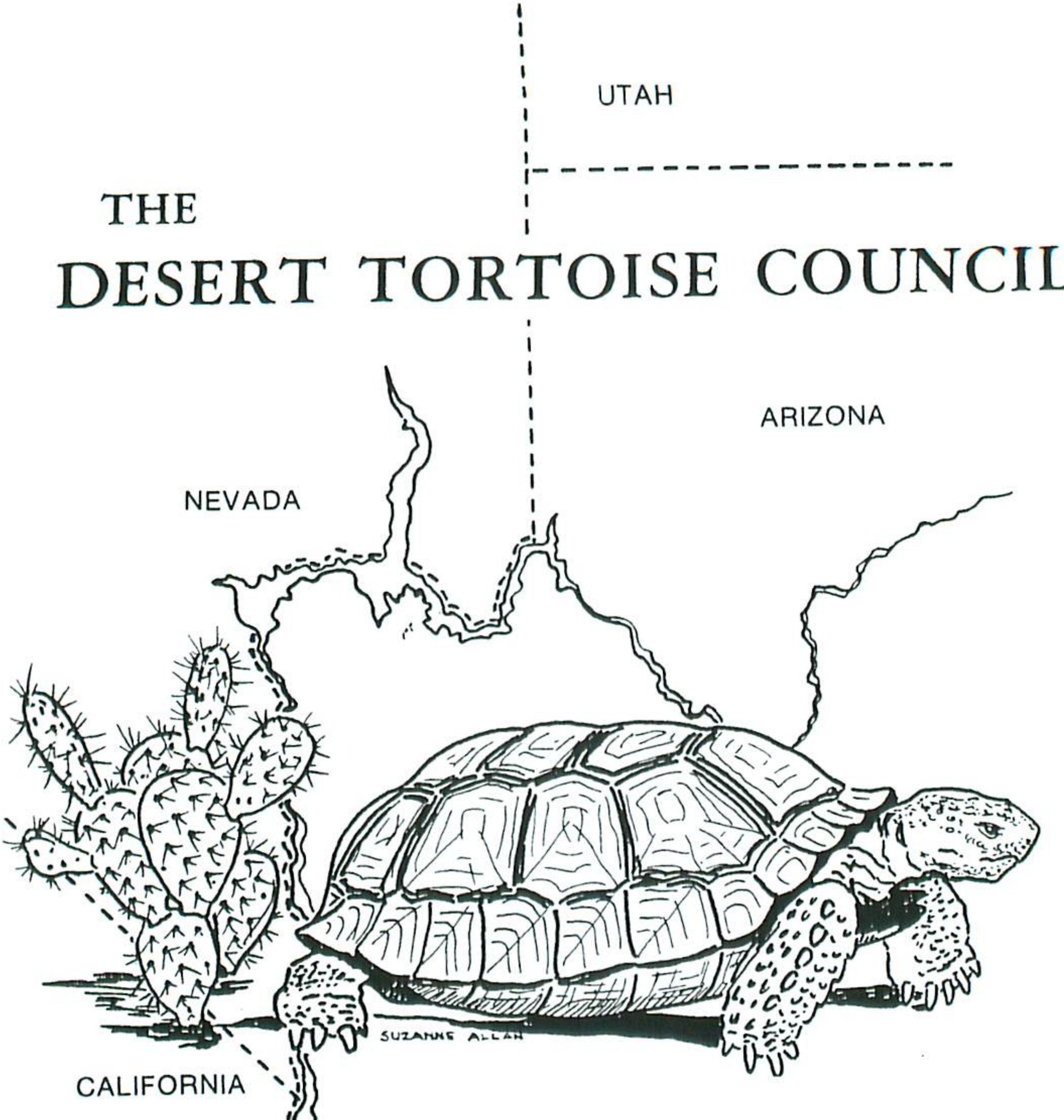
Elroy Masters: Fish, Wildlife, and Threatened and Endangered Species Program Lead

Bureau of Land Management, Nevada State Office, Reno, NV

The Bureau of Land Management (BLM) administers approximately 4.5 million acres of desert tortoise habitat in Clark, Lincoln, and Nye counties, Nevada. Of these acres, 1,085,000 acres were designated as Critical Habitat on February 8, 1994. Desert tortoise habitat is managed out of the Las Vegas, Tonopah and Caliente Field Offices. The following are some of the highlights and future activities identified in 2007 and 2008. The Las Vegas Field Office is in the process of requesting a 20-year mineral withdrawal on approximately 900,000 acres within desert tortoise, cultural and biological Areas of Critical Environmental Concern (ACECs). Section 7 consultation on land use plans and individual projects remain a major work load for the

EXHIBIT 445

THE DESERT TORTOISE COUNCIL



ABSTRACTS

34th ANNUAL SYMPOSIUM

February 20–22, 2009

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

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

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

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

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

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

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

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

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

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

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

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

Tortoises Crossing Roads: The Science for the Solution

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

The Effects of Dogs on Wildlife Communities

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

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

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

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

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

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

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

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

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

EXHIBIT 446

ABSTRACTS

THIRTY-FIFTH ANNUAL MEETING AND SYMPOSIUM

THE DESERT TORTOISE COUNCIL

Doubletree Hotel, Ontario, CA
February 25–28, 2010

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

Defenders of Wildlife 2010 Abstract: Desert Tortoise

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Defenders of Wildlife first launched its locally-based California Desert Campaign in 2005. This work focused on the Western Mojave Desert, which is currently undergoing the most intense development pressure. Desert Tortoise work is a key component for Defenders. We have established a permanent presence in the California desert to work with the public, local governments, and management agencies. We have staff based in both Sacramento and Joshua Tree to accomplish this objective.

The California Desert is under tremendous pressure from renewable energy proposals. Defenders is committed to protecting the natural habitat of the California Desert. We have hired additional staff, Jeff Aardahl, to work on renewable proposals. America needs to get away from burning the fossil fuels that are polluting our planet and causing global warming. Renewable power from solar and wind are key elements in the transition to a clean-energy future, but we must make sure that renewable energy development doesn't also ruin irreplaceable landscapes such as the scenic Mojave desert, or impact sensitive wildlife such as desert tortoises, burrowing owl, Mohave ground squirrel and migratory birds.

Defenders work on renewable energy projects in the California Desert includes solar thermal, photovoltaic, geothermal, and wind projects. The environmental values and biological integrity of much of the California Desert Conservation Area (CDCA) is at risk because of recent commercial interest in building and operating industrial-scale solar and wind energy projects. Beginning in 2007 and continuing through 2010, commercial solar and wind energy companies filed over 130 right of way applications with the Bureau of Land Management for solar and wind energy projects covering one-million acres of public land in the CDCA. This abrupt interest in using public lands for solar and

wind energy production coincided with two renewable energy utilization mandates from the State of California in 2006 and 2008.

In addition, Defenders, in an effort to reach out to Latino communities, have translated our educational brochures into Spanish both in print and on our website. We also have participated in a Native American Lands Conservancy Symposium, Raven Management Group, Mohave Ground Squirrel Conservation Plan, the Desert Managers' Group, Desert Tortoise Education Group, and the Desert Tortoise Recovery Plan.

Defenders is also working on climate change adaptation. This work includes land conservation planning, wildlife linkages and sponsoring the third annual Climate Change Seminar on March 12.

Impacts of Anthropogenic Nitrogen Deposition on Invasive Species and Fire Risk in California Deserts

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Invasive species have had major impacts on the California deserts, having such high productivity in some regions that they may both exclude native vegetation and be responsible for increased fire frequency. One of the anthropogenic factors that increases productivity of annual vegetation is nitrogen deposition that originates from urban (oxidized N, primarily from automobile emissions) and agricultural (reduced N) areas. Most of the N pollution occurs as dry deposition that accumulates on plant and soil surfaces and is available for plant uptake in mineral form at the beginning of the rainy season. The amounts of N deposition are as high as 16 kg N ha^{-1} yr^{-1} in the Coachella Valley, declining to background levels of <2 kg ha^{-1} yr^{-1} in the eastern Mojave and Sonoran Deserts. We used three approaches to test the impacts of N deposition. We 1) measured annual vegetation response to N along a N deposition gradient from 3-12 kg N ha^{-1} yr^{-1} (east to west) at Joshua tree National Park, 2) fertilized plots at four sites in the Park at levels of 0, 5 and 30 kg N ha^{-1} yr^{-1}, and 3) used a biogeochemical model, DayCent, to model the productivity of annual vegetation under varying precipitation and N deposition, and to assess the risk for fire assuming at least 1 T/ha of fine fuel is needed to carry a fire. We measured the responses of native and invasive plant species at the field sites over 5 years and in an experimental garden under varying soil moisture levels to parameterize the DayCent model. We also assessed diversity of native herbaceous vegetation in response to changes in invasive species in the field sites.

The dominant invasive species were *Schismus barbatus* and *Erodium cicutarium* at the lower elevations in creosote bush scrub (CB), and *Bromus madritensis* at the higher elevations in pinyon-juniper woodland (PJ). Some 90 species of native herbaceous species were recorded in fertilized plots over the 5 years. Each of the two fertilized vegetation types were located in a relatively high and a low N deposition area. Exotic grass biomass increased significantly with 30 kg N/ha at three of the four sites during a year with moderate precipitation, and under 5 kg N/ha at two sites during a year with high precipitation. The response of native forbs to fertilizer was related to the amount of exotic grass present initially. The richness of native forbs declined with fertilization at a site with high initial exotic grass cover, but native richness and cover increased with fertilization at a site with low grass cover. Sites with low air pollution were not necessarily the sites with lowest invasive cover, as soil texture (rockiness and clay) also controls ability of invasive species to colonize and the N supply to plants, and further work is underway to test the relationship between soil texture and invasive species dominance.

The DayCent model showed that fire risk, calculated as the probability that annual biomass exceeds the fire threshold of 1 T/ha, increased with increasing N and precipitation, and was also controlled by soil texture. Critical loads of N deposition were determined as the amount of N deposition at the point when fire risk began to increase exponentially. Average critical loads for all soil types and precipitation < 21 cm/yr, representing the majority of our study region, were 3.2 and 3.9 kg N/ha for CB and PJ, respectively. Fire risks approached their maximum at 9.3 and 8.7 kg N/ha in CB and PJ; precipitation is the driver of fire above these N deposition levels. Levels of N deposition at the maximum fire risk load, a mean value of 9 kg ha^{-1} yr^{-1}, occur over 1.5% of the California deserts, mainly in the western Mojave and Coachella Valley, while the minimum critical load, 3.6 kg ha^{-1} yr^{-1}, occur over 32% of the deserts. This indicates that one-third of the desert is potentially subject to increased productivity of invasive species because of N deposition, coupled with decreased native diversity and increased fires. Vegetation recovery from fire is slow in deserts, and burned areas are often dominated by exotic annuals for decades after a burn. Additional work is underway to determine the relationship of past fire occurrence with areas of varying N deposition. Control of N deposition from air pollution may be an important management goal in reducing productivity of invasive grasses and their negative effects on desert ecosystems.

Continuing Efforts to Protect and Recover the Desert Tortoise

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For over a dozen years, the Center for Biological Diversity has focused its desert tortoise conservation and recovery efforts first in the California Desert Conservation Area (CDCA) and now expanded into Nevada, Utah and Arizona through advocacy, participation in administrative processes and, when necessary, litigation. Using the best available science, the Center has supported increased protection for the desert tortoise as a stepping stone towards desperately needed recovery of the species. Habitat protection for desert tortoise also protects innumerable other species, both rare and common that make the iconic western deserts their home. Our campaigns have changed the dialogue for desert tortoise conservation and resulted in on-the-ground actions from ORV route designation review in key tortoise habitat, to improvements in tortoise translocation efforts, to increasing meaningful conservation strategies for tortoise. Looking forward, these efforts will be even more important as we work to protect the desert tortoise and its remaining habitat from destruction and fragmentation threatened by the glut of currently proposed renewable energy projects across the southwestern states.

We still believe that more protection and recovery efforts need to be focused on the desert tortoise because of the continuing and troubling population declines. Updates on the current legal challenges including the BLM's CDCA plan amendments and related actions and the Arizona strip case will be discussed. The on-going tragic failures of the Fort Irwin "first phase" translocation and our efforts to carefully craft renewable energy projects to avoid impacts to desert tortoise throughout its range will be reviewed. Our National Monument or Conservation Area campaigns for Gold Butte and the upper Las Vegas Wash will be highlighted as a model for desert tortoise conservation. Other ORV issues, water issues and development plans will also be discussed.

Progress Report on the Desert Tortoise from the Desert Tortoise Recovery Office, U.S. Fish and Wildlife Service

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No Abstract available.

Effects of Sahara Mustard, *Brassica tournefortii*, on a Desert Landscape

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Given the abundance of non-native species invading wildland habitats, managers need to employ informed triage to focus control efforts on weeds with the greatest potential for negative impacts. My objective was to determine the level of threat Sahara mustard, *Brassica tournefortii*, represents to meeting regional goals for protecting biodiversity. Sahara mustard has spread throughout much of the Mojave and lower Sonoran Deserts. It has occurred in southern California's Coachella Valley for nearly 80 years, punctuated by years of extremely high abundance following high rainfall. In those years the mustard has clear negative impacts on the native flora. Using mustard removal experiments I identified reductions in native plant reproduction, shifting composition increasingly toward Sahara mustard while decreasing the fraction of native species.

Without control measures the long-term impacts to desert biodiversity will be an increasing decline in native annual plants, with potential broad trophic impacts. High between-year variance in precipitation may be a key to maintaining biodiversity as the mustard is less abundant in drier years. Without control, the fate of Sahara mustard and the desert's biodiversity may rest on a changing climate. Drier conditions will keep the mustard from becoming dominant but will likely have other negative consequences on the native flora and fauna.

Renewable Energy Development and Desert Tortoise Conservation: Is Industrial Development of the Desert Compatible with Survival and Recovery?

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The Center for Biological Diversity has consistently advocated for the enforcement and expansion of protections for the threatened desert tortoise in the media, the administrative process and, when necessary, through litigation for over 20 years. The Center remains focused on science-based advocacy to ensure that land use planning and management on public lands as well as site specific decisions on both public and private lands provide effective protection for the desert tortoise and other imperiled species that will support recovery. To that end, the Center focuses our efforts on using existing environmental laws, including NEPA and ESA as well as state laws, to ensure that public agencies prioritize the survival and recovery of listed species in their management of public lands and in funding or carrying out projects.

As of September 2009, there were over 150 proposals for large industrial-scale renewable energy projects pending in the California Desert alone with dozens more proposed in Nevada, Arizona and Utah within the range of the listed population of the desert tortoise. A subset of about 18 of these projects (12 in the California Desert), called the "fast track" projects, are racing to be permitted and "shovel ready" by the end of 2010 to secure federal stimulus grant funding. In addition, new utility line proposals to service new generation facilities have the potential to further fragment habitat and act as a magnet drawing development into inappropriate areas.

The solar proposals on public lands in the CDCA alone (about 63 applications) cover over 500,000 acres, including many thousands of acres of occupied desert tortoise habitat. The scale of individual projects is unprecedented with many proposals covering 4,000-6,000 acres or even up to 10,000 acres of contiguous lands. The proposed projects run the gamut from previously disturbed private lands formerly used for farming in the desert to intact high quality occupied desert tortoise habitat on public lands. At least one wind generation proposal would impact over 1,500 acres of occupied desert tortoise critical habitat on Daggett ridge in the Ord-Rodman DWMA near a long term desert tortoise study site.

The Center is concerned that direct impacts to tortoises and habitat, as well as indirect and cumulative impacts from multiple projects, may undermine ecosystem integrity causing the collapse of subpopulations across the range. One example of an areas of concern is the Ivanpah Valley, much of which was identified for desert tortoise conservation in the 1994 Recovery Plan (see map at page 41) and supports a diverse and biologically rich suite of plants and animals, including the threatened desert tortoise. Presently, five large solar projects are proposed in the Ivanpah Valley, two in the northern Ivanpah Valley in California and three on the eastern side of the valley in Nevada. After taking a detailed look at the biological resources of northern Ivanpah Valley, including new information from surveys conducted by the solar companies that want to develop the area, it is clear that this area should be secured for long-term conservation and recovery of the desert tortoise and other species. Indeed, once again, we can see the foresight and accuracy of those scientists who drafted the 1994 Desert Tortoise Recovery Plan which identified this area for protection for the benefit of the desert tortoise. Unfortunately the BLM declined to follow the direction of the 1994 Recovery Plan in managing the public lands and excluded large areas of the Ivanpah Valley from protection in the DWMA, as a result, the Center and other conservation groups have needed to step up to fight for protection in this area.

As many of you know, the Center for Biological Diversity has also worked diligently to press government agencies to take the threat of global warming seriously, to utilize existing laws and enact new laws to move us towards significant reductions in greenhouse gas emissions. The Obama administration and the State of California have recently taken significant steps in that direction which we applaud.

The need to replace energy sources that emit large amounts of greenhouse gases is clear. We need to develop renewable energy *but we need to do it right*. We need to put large industrial-scale projects in *appropriate* places not in areas where they will displace significant populations of desert tortoise, destroy habitat and highly functioning ecosystems. Certainly some compromises will need to be made at the margins, but siting of large scale industrial facilities must take into account the facts on the ground, not only the preferred design of the developers. Alternative sites and alternative ways of meeting energy demand, including conservation and distributed renewable energy development, must all be fully explored as well.

Planning efforts by the BLM, state, and local agencies for the California Desert never contemplated this level of large scale industrial development, and, as a result, no planning was done. As a result, while many project proposals are moving forward in a scatter shot fashion and sprawling across the landscape, the BLM is at the same time undertaking planning efforts to find areas (or zones) to group projects near existing or approved transmission and to the extent possible in areas that are already disturbed. We applaud the BLM's new planning effort but fear it may be far too late if projects are approved piecemeal and "zones" are created by the momentum of industry lobbying instead of by rational planning principles. As those who have studied the desert well know, the impacts to the land and habitat are long term – if not permanent— even where there is funding for restoration efforts and the will to undertake them. Before any more desert tortoise habitat is lost, thoughtful and careful environmental review and planning must be completed.

Finally, there is also a new planning effort to support desert tortoise recovery through mitigation funds that will be acquired from large industrial scale development in the desert. The Renewable Energy Action Team ("REAT") which includes BLM, FWS, CDFG, and CEC, is currently developing a conservation plan, the Desert Renewable Energy Conservation Plan ("DRECP"), that will identify high priority land acquisitions and recovery actions to help coordinate and potentiate future mitigation efforts. The Center applauds any efforts to increase recovery actions for the desert tortoise and provide more protection of critical habitat and other conservation lands, and to increase the land base that is protected for conservation. To that end, the Center intends to work closely with the agencies to develop a robust science-based plan with meaningful enforceable protections for many species across the desert landscape. However, *mitigation cannot replace conservation.* First and foremost, impacts to high quality occupied desert tortoise habitat must be avoided. Only after all avoidance measures have been explored and put in place (including alternative siting where necessary) should mitigation measures be implemented.

In sum, the Center for Biological Diversity supports renewable energy development in the right places which can be identified through an open public process using the best available science and good planning principles. The Center will continue to advocate for the protection of the desert tortoise and all imperiled species on both the local and regional level and advocate for science-based efforts to recover this keystone species of the southwestern deserts.

A Model of the Invasion and Establishment of Sahara Mustard (*Brassica tournefortii*) in the Western Sonoran Desert

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We studied the invasion and establishment of Sahara mustard, *Brassica tournefortii* Goan, at a 4.66 km^2 site in the Chemehuevi Valley of the western Sonoran Desert, California, USA. We used mixed data sets of photographs, transects for biomass of annuals, and densities of *B. tournefortii* collected at irregular intervals between 1979 and 2009. We suggest that *B. tournefortii* may have been present along the main route of travel, a highway, in low numbers in the late 1970s, and invaded the site from the highway and along a major microphyll woodland wash. In 1999 *B. tournefortii* density ranged from 0.55 plants/m^2 at the highway edge to 0 per transect at ~1700 m from the highway. By 2009, *B. tournefortii* density ranged from 33 plants/m^2 at the highway to 1.59 plants/m^2 ~1700 m from the highway. In addition, *B. tournefortii* had become established throughout the valley.

To develop a predictive model for invasibility of this region by *B. tournefortii*, we evaluated relationships of surficial geology/soils, habitat type, and distance to the highway on *B. tournefortii* density in 1999 and 2009. *Brassica tournefortii* densities differed significantly by surficial geology/soils and distances to the highway. During the initial invasion, significant predictor variables were proximity to the highway and to the microphyll woodland wash, as well as number of nearby washlets. However, once *B. tournefortii* was well established, proximity to the highway and number of washlets were the only significant predictor variables. Microhabitats also influenced density of *B. tournefortii*. *Brassica tournefortii* densities were higher under shrubs in washlets than in open desert under shrubs or intershrub spaces. Overall, *B. tournefortii* thrives in disturbed areas along road edges, in poorly developed soils, and on young geological surfaces. It is highly successful in naturally disturbed areas, such as within shrubs in washes and washlets. The ability of *B. tournefortii* to rapidly colonize and become established in the desert Southwest poses severe threats to the well-being of desert ecosystems.

Highway 58 Fence Study Reloaded: Effectiveness of a Highway Barrier Fence after 19 Years

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Roads and highways pose a threat to many vertebrates due to natural movements and dispersal patterns of these animals. In some cases, this mortality may be compensatory, but in others the rates of mortality may be high enough to cause population declines. Barrier fences, if properly designed and maintained, can effectively mitigate against such mortality, and if they do, they can be viable mitigations to the impacts ofsolar and wind energy developments. We conducted surveys for desert tortoise sign within 1.6 km of the edge of Highway 58, where a barrier fence was constructed in 1990, and Highway 395, where no tortoise barrier fence exists. We compared the results to similar surveys conducted in 1991 and 1994. In 2009, we documented a decline by 83% in tortoise sign, and by inference, tortoise relative density, within 1.6 km of both highways. However, we also documented an increase in the number of burrows and proportion of sign occurring within 400 m of the edge of fenced Hwy 58 since 1991. In 2009, there was more sign within 200 m of fenced Hwy 58 compared to unfenced Hwy 395. Even after 19 years of the fence being in place, there is still a road effect; however that effect appears to have diminished. The amount of habitat “reclaimed” by tortoises along 1.6 km of Highway 58 is equivalent to 30 hectares of habitat not directly affected by the highway.

Is Translocation a Viable Option for Desert Tortoises: Measuring Short- and Medium-term Effects of a Large-scale Translocation Project

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Translocation is a highly controversial management strategy, because success of most projects is relatively low. More troubling is that translocations of threatened, endangered, and sensitive species have resulted in lower success rates than other groups. Translocation of desert tortoises was a tool approved to mitigate the acquisition of 110,000 acres for the expansion of Fort Irwin to facilitate more realistic training scenarios. Tortoises are being translocated from two areas: the Southern Expansion Area (23,000 acres) and the Western Expansion Area (69,500 acres). We are studying six primary measures of success (survival, dispersion, burrow use, reproduction, genetic assimilation, and habitat use) using up to 216 translocated, 108 resident, and 109 control animals. We are also comparing various modes of translocation (soft-release, hard-release, pens, and short versus long-distance). Preliminary trends revealed by some of these studies will be reported.

Reducing Raven Predation on Desert Tortoises: Does Removing Nests Prevent Ravens from Continuing to Nest?

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The common raven is an important predatory species that is hampering the recovery of threatened desert tortoise populations in the Mojave Desert. Habitat Conservation Plans and Biological Opinions for alternative energy and other developments usually include stipulations designed to reduce the probability that a development will facilitate an increase in raven presence and their predation on nearby tortoise populations. One of those conditions is the removal of raven nests. Here I report on the experimental removal of raven nests to determine if this is a viable management option. For three years, nests were searched for and removed on the 13-km^2 Hyundai Automotive Test Site Facility. Nests were also monitored within approximately 1.6 km of the perimeter to serve as references. A total of 35 to 62 raptor nests were observed each year. Thirty-eight (12.7 per year) were removed from the test site. A total of 53% were rebuilt within 1- 3 months of when the originals were removed and a few were removed more than once in a season. Annual nest removals resulted in 44% fewer nests occurring on the site. During the same time, there was a 15% reduction in nests off site,

where we did not remove nests. This indicates that birds probably did not simply move into the area surrounding the test site to nest, but rather skipped nesting altogether for the year. Annual nest removals did reduce the number of ravens nesting in the area, but the removals would have little effect if not coupled with other actions.

Management of Desert Tortoise Habitat on Public Lands Managed by the Bureau of Land Management – Nevada

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The BLM administers about 4.5 million acres of desert tortoise habitat in Clark, Lincoln, and Nye counties in Nevada of which 1,085,000 acres are designated as Critical Habitat. The Battle Mountain, Ely, and Southern Nevada District offices coordinate and conduct the majority of BLM's management activities for desert tortoise. The following are highlights from NV BLM's 2009 accomplishments. The BLM has successfully created a 20-year mineral withdrawal on 24 Areas of Critical Environmental Concern (ACECs) totaling nearly 945,000 acres in Clark and Nye counties in southern Nevada. Additionally, BLM is working with Partners in Conservation and the Southern Nevada Site Stewardship Program to monitor designated roads in desert tortoise ACECs over the next two years. This effort will reduce and repair resource injuries across 700,000 acres. The NV BLM continues to implement recovery actions including: (a) monitoring locations for desert tortoise habitat conditions and desert tortoise populations in Lincoln Co.; (b) reclaiming over 17 miles of roads and (c) installing over 15 miles of fencing at numerous locations that were being continually disturbed by motorized vehicles; (d) successfully obtaining competitive funding from the Mojave Desert Institute to create about 13 miles of fuel breaks in desert tortoise habitat to prevent large habitat losses due to fire; and (e) continued implementation of the Ely District Resource Management Plan that includes creating management plans for three ACECs within the next three years. Section 7 consultation remains a major workload for the Districts. Wildfires in desert tortoise habitat will continue to receive priority response; this includes emergency stabilization and restoration plans developed to rehabilitate the burned areas as quickly as possible. The BLM is continuing to monitor post-fire vegetation treatments.

San Diego's Renewable Energy Future is Bright

Alan Colton, Manager of Sunrise Powerlink Environmental Services

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San Diego Gas & Electric Company (SDG&E) is committed to providing safe, reliable energy to our customers in the most environmentally responsible manner possible. Using the power of the sun, wind and geothermal sources are ways that SDG&E is fulfilling this commitment. SDG&E's programs and services help promote energy-efficiency, sustainability, and renewable energy solutions.

SDG&E supports the state's priority of making California the nation's leader in solar energy. Our regional energy plan is a balanced plan that includes energy-efficiency and demand-response programs, more energy from renewable sources, as well as new electric transmission and generation. We will meet the state requirement of delivering 20 percent of the power from renewable sources by this year, and 33 percent by 2020 as required through an executive order issued by Governor Arnold Schwarzenegger.

With the California Public Utilities Commission's ("CPUC") approval, up to $250 million will be invested in solar installations throughout the greater San Diego area over the next five years as part of San Diego's largest solar initiative. This innovative program will spark a partnership between businesses, municipalities, and institutions to dramatically increase the use of photovoltaic (PV) tracking technology at shopping centers, schools, open places and landfills.

SDG&E has a 20-year contract with Stirling Energy Systems' (SES) to purchase up to 900 megawatts of solar energy generated by up to 36,000 SunCatcher dishes spread across ten square miles in the Imperial Valley. This will be one of the world's largest solar power projects. SDG&E has signed other contracts and continues to solicit and review several thousand megawatts of proposed generation facilities to deliver energy from various sources including solar trough technology, wind, geothermal, and biomas.

One of the difficulties encountered by the renewable energy providers is having adequate transmission capacity for delivering their energy to market. Without a delivery source the energy providers are not able to secure adequate funding. SDG&E has recognized this issue and is seeking to permit and construct a new high-voltage transmission line between San Diego and Imperial Valley called the Sunrise Powerlink. The Sunrise Powerlink is a key element of SDG&E's regional energy plan to improve the reliability of the power grid and increase the use of renewable energy. The 120-mile transmission line is expected to be completed in 2012 and will deliver new supplies of needed electricity to homes and businesses and connect the region to clean solar, wind and geothermal projects located east of San Diego.

The future looks bright for renewable power in San Diego. Vast supplies of solar, wind and geothermal energy are sitting untapped in eastern San Diego County and the sunny deserts of Imperial Valley. Together, these regions could become a leading producer of renewable power and help reduce polluting greenhouse gas emissions in California.

Update on Desert Tortoise Protection Efforts by Western Watersheds Project

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Western Watersheds Project (WWP) works to protect and conserve the public lands, wildlife, and natural resources of the American West through education, public policy initiatives and litigation. In October 2008, WWP and WildEarth Guardians petitioned the Secretary of the Interior to list the Sonoran desert tortoise population as a Distinct Population Segment under the Endangered Species Act and to designate Critical Habitat. On August 28, 2009 the USFWS issued a positive 90-day finding on that petition. The Sonoran desert tortoise occurs in southwest Arizona and northern Mexico. The USFWS found that Sonoran desert tortoises qualify as a distinct population, different from other tortoises found in the Mojave Desert west of the Colorado River that were federally listed in 1990. The USFWS finding also addressed the unlisted population of Mojave type desert tortoises that live in the Black Mountains in northern Arizona. The USFWS determined that the Sonoran desert tortoises may be threatened by all five factors the agency uses in deciding whether a species qualifies for Endangered Species Act protection: 1) habitat loss and destruction; 2) overutilization; 3) disease or predation; 4) inadequate legal protections; and 5) other factors. Under the Act, the tortoises needed to qualify under a minimum of just one of these factors. The full list of threats noted in the 90-day finding include: habitat loss from livestock grazing, urbanization, border activities, off-road vehicles, roads, mining, harm to individual tortoises from shooting, collection for pets or food, diseases such as upper respiratory tract disease, shell disease, and other pathogens; increased predation by ravens, coyotes, and feral dogs; inadequate legal protections, including on federal and state public lands; altered fire patterns due to exotic weeds; crushing and killing of tortoises by off-road vehicle users; and prolonged drought, exacerbated by the climate crisis. WWP and WildEarth guardians are working with USFWS to ensure that the one year status review triggered by the 90-day finding is completed in a timely manner.

WWP is currently engaged in litigation with the Bureau of Land Management (BLM) over cattle grazing on the Sonoran Desert National Monument. WWP's litigation on the Sonoran Desert National Monument hopes to attain improved interim management for desert tortoise habitat pending the completion of the Monument Resource Management Plan. Elsewhere in Arizona, WWP has been protesting proposed grazing decisions within desert tortoise habitat based on BLM Determinations of NEPA Adequacy tiered to Environmental Impacts Statements completed over two decades ago.

WWP continues its efforts to conserve listed Mojave desert tortoise populations and to ensure that recovery measures are based on best available science. WWP is challenging an experimental restoration project proposed within Mojave desert tortoise habitat in Arizona, Utah, and Nevada where the BLM is proposing using non-native vegetation. WWP is concerned that effects to tortoise and other habitats were not properly considered. WWP is actively involved in reviewing many of the industrial-scale renewable energy projects that have been proposed in desert tortoise habitat throughout the Mojave Desert. In addition to massive direct loss of habitat, these projects threaten to further fragment habitat and disrupt connectivity between the evolutionarily significant units identified in the 1994 Recovery Plan.

STUDENT PAPER

Potential Conservation Benefits of Multiple Paternities in the Threatened Desert Tortoise, *Gopherus agassizii*

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Conservation of the desert tortoise (*Gopherus agassizii)* depends largely on maintaining the maximum amount of remaining genetic and individual diversity in the species. One of the factors which affect the expression of genetic variation is the number of sires whose genes are expressed in each clutch. Thus, understanding paternity patterns improves our ability to develop effective plans for tortoise conservation. We analyzed paternity of desert tortoise clutches at Edwards Air Force Base (EAFB) and Twentynine Palms Marine Corps Air Ground Combat Center (Twentynine Palms), California, during the course of ongoing headstart programs operating at both sites. We used 20 microsatellite loci to genotype mothers, neonates, and potential fathers encountered in the vicinity. We included nests with ≥3 neonates from which genotypes could be obtained in the paternity analysis. We used both conservative criteria (requiring evidence from 2 or more loci) and less rigid criteria (requiring evidence from only 1 locus) to estimate the incidence of multiple paternities at each site. At EAFB, 50 to 100% of the nests were sired by multiple males, and at Twentynine Palms 58 to 83% of nests showed evidence of multiple paternity. Desert tortoises clearly exhibit multiple paternities, which may have

important implications for their conservation, and raises interesting questions about female choice in this species.

Managing Desert Tortoise on California BLM lands: Can We Chart the Path to Recovery Amidst Renewable Energy Development?

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In 2009, the Bureau of Land Management (BLM) continued to work on projects such as tortoise translocations associated with Fort Irwin Expansion, signing Northern and Eastern Colorado desert routes (especially in the Chuckwalla Bench Desert Wildlife Management Area) as the first step in habitat restoration efforts, the in-depth tortoise study initiated in 2008, acquisitions of private land, and conducting desert tortoise surveys in several areas. We funded an evaluation of the effects of the Hwy 58 fencing on tortoise mortality and densities, 19 years post construction. Additionally, we have coordinated with US Fish and Wildlife Service on data needed for their spatial decision support system, a tool that will assist land mangers in assessing the benefits of different recovery actions for tortoise and help in the prioritization of these actions. However, most of our effort and time was focused on solar and wind energy projects. Industrial renewable energy development projects are of a size and scale that California BLM has not previously contemplated nor envisioned. We face a huge challenge of managing the public trust. With the potential loss of thousands of acres to a single use and the projected mitigation requirements and associated funding, we want to be strategic in how mitigation is applied to get the maximum benefit for the tortoise, and other wildlife species. While many argue that renewable energy will be the demise of the tortoise, we ask, "Could industrial renewable energy provide an unprecedented opportunity to implement suites of targeted recovery actions and actually move the tortoise towards recovery?" In coordination with Fish and Wildlife Service and California Department of Fish and Game, BLM is striving to chart that path.

Health, Behavior, and Survival of 158 Tortoises Translocated from Ft. Irwin: Year 2

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A sample of 158 desert tortoises from Ft. Irwin's Southern Expansion Area (SEA) was translocated in the spring of 2008 to four study plots located outside the SEA. Prior to translocation, tortoises were grouped into one of four health categories. Tortoises were monitored on a regular basis and have received comprehensive health evaluations during each spring and fall. We evaluated the development of new diseases, survival, movement patterns, and changes in clinical signs of disease and trauma after translocation. These responses were compared among health categories, sexes, and release plots. Overall, there has been an increase in prevalence of mycoplasmosis (2.8–2.9% tortoises with positive or suspect ELISA tests for *Mycoplasma agassizii* in 2008; 4.9–9.2% in 2009). Deaths of translocated tortoises, primarily from predation, have remained high in 2008 (27.2%) and 2009 (23.5%), and death rates varied among plots. Movement parameters also differed among years, seasons, sexes, and plots. Tortoises have dispersed up to 12.5 km from their release sites, with a mean dispersal distance of 2.5 km. Our results provide evidence that tortoises have begun to settle and that increased activity levels are associated with increased risk of mortality. Future work will entail continued monitoring and health evaluations, analyzing clinical signs of disease and trauma, and quantifying differences in habitat among study plots. We place the preliminary results of this study in context with future translocation projects.

Illegal Collection of Desert Tortoises in the Sonoran Desert

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The expansion of human transportation infrastructure into desert tortoise (*Gopherus agassizii*) habitat in the Sonoran Desert has raised questions concerning the appropriate mitigation strategies to reduce impacts at the population level. While direct impacts (namely road-kill mortality and habitat loss) have been well documented, indirect impacts such as illegal tortoise collection have been insufficiently addressed. From a management perspective, it has become increasingly important to understand the cumulative impacts that roads have on tortoises. We estimated the probability of desert tortoise collection along three road categories to evaluate whether collection probabilities were related to road type. The predicted probability of a motorist detecting a desert tortoise was highest on maintained gravel roads and lowest on non-maintained gravel and paved roads. Given tortoise detection, motorist response varied by road type with the probability of tortoise collection highest on maintained gravel roads. We discuss the implications that these results have for comprehensive road mitigation strategies.

POSTER

Landscape-Level Habitat Models for Desert Tortoises in Southwestern Arizona

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The Arizona Game and Fish Department is developing a landscape-level habitat model to predict desert tortoise (*Gopherus agassizii*) occupancy on three military installations in southwestern Arizona (i.e., U.S. Army Yuma Proving Ground, Barry M. Goldwater Air Force Range, and Marine Corps Air Station, Yuma). These models will assist natural resource managers in identifying potential conflicts between desert tortoise conservation and maintaining the military's mission with the overall goal of reducing conflicts and mitigating the potential impacts of military training activities. We present preliminary results of our first year of research and the anticipated benefits of taking a landscape-level approach to desert tortoise conservation on these installations.

POSTER

Modeling Desert Tortoise Occupancy on the Florence Military Reservation, Pinal County, Arizona

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The Florence Military Reservation (FMR), located in Pinal County, Arizona serves as a desert training complex for the Arizona Army National Guard. The installation also provides habitat for desert tortoises (*Gopherus agassizii*). The goal of this study was to evaluate the distribution of desert tortoises within the FMR training area and develop recommendations to minimize impacts to tortoises while maintaining the National Guard's military readiness mission. We conducted standardized tortoise surveys on 228 3-ha survey plots and calculated occupancy estimates using a likelihood-based approach which allowed us to estimate the proportion of area occupied (PAO) as well as detection probabilities. We also examined the influence of site- and survey-specific covariates on detection probabilities and PAO. Detection probability was best modeled as a function of time, being highest during the early morning surveys (i.e., sunrise to 10am) and declined as the day progressed. The average detection probability across all the survey plots was 0.307 (range: 0.209 to 0.400; *SE* = 0.054). The overall PAO was estimated at 0.216 (*SE* = 0.055). Our results indicate that tortoises were 1.67 times more likely to occupy a plot with each caliche cave present. Desert tortoises were 0.45 and 0.35

times as likely to occupy a plot when roads and cattle sign were present, respectively. We discuss management recommendations for reducing impacts to desert tortoises on the FMR based on the results of this study.

2009 RECIPIENT OF THE DAVID J. MORAFKA MEMORIAL RESEARCH AWARD

The Prevalence and Distribution of *Mycoplasma agassizii* in the Texas Tortoise (*Gopherus berlanderii*)

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Upper respiratory tract disease (URTD) caused by *Mycoplasma agassizii* is characterized by ocular and nasal discharge, conjunctivitis, and decreased appetite and lethargy. Significant morbidity and mortality can be caused by the secondary effects of this disease including generalized malaise and decreased visual and olfactory function. URTD has been associated with major losses of free-ranging desert tortoises (*Gopherus agassizii*) and gopher tortoises (*Gopherus polyphemus*) in the United States. This has prompted investigation into the prevalence and distribution of the disease in the Texas tortoise (*Gopherus berlandieri*). Blood samples were taken from 40 Texas tortoises for detection of anti-mycoplasma antibodies by ELISA. Of the 40 tortoises, 11 were seropositive indicating that they had been exposed to mycoplasma and developed a detectable immune response. Twenty six of the tortoises were seronegative, and three were suspect for antibodies against *M. agassizii* on the ELISA test. Seropositive tortoises were found on both public and private lands in Cameron and Hidalgo counties of south Texas. Nasal lavage samples were collected for culture and detection of *Mycoplasma agassizii* gene sequences by polymerase chain reaction (PCR). Of the 35 tortoises that had nasal lavage performed, only one was positive on culture and PCR for *Mycoplasma* organisms.

Reproductive Nutrition Revisited

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We evaluated whether dietary nitrogen concentration, food consumption, and nitrogen consumption affect the reproductive output of female desert tortoises.

Reproductive output did not vary with the concentration of nitrogen (0.5 to 3.0%), but female size and condition affected reproductive output (e.g., clutch size, fecundity, egg size, clutch mass and clutch nitrogen content). Body reserves probably enabled some females to produce eggs while eating the low nitrogen diets (0.5 and 1.0% N). Neither nitrogen intake nor food intake affected reproductive output of the first (immediate) reproductive season, but reproductive output in the second year was correlated to nitrogen intake, especially nitrogen intake during the first year. These correlations correspond with vitellogenesis of the largest ovarian follicles before winter, although small follicles may also develop at this time. There appears to be a trade-off between current and future reproduction, especially with regards to nitrogen intake in spring. The highest food and nitrogen intakes occurred shortly after females oviposited, suggesting a constraint of current reproductive state on the nutrient intake that influences next year's reproductive output.

QuadState Local Governments Authority: A Partner in Desert Tortoise Recovery

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QuadState LGA continues to speak for and represent local governments in the Mojave and Sonoran Deserts. During the past year it has grown to eight counties, with the addition of La Paz County Arizona. During the past year we have remained engaged with the land management and wildlife agencies regarding both the Mojave and Sonoran Populations of desert tortoise.

Regarding the Mojave Population we await, like many others, the release of the reviewed and revised recovery plan. We look forward to working with the State and Federal agencies on implementation. Counties are actively engaged with the California Desert Managers Group, and have been accorded membership as public agencies in the Management Oversight Group. We participate in the Mojave Desert Initiative which covers the three eastern states, and we provide a conduit of information regarding wildlife and land rehabilitation between the State and Federal agencies and local governments. QuadState grew from a need by the counties for services and advice regarding tortoise, and other natural resources and public lands issues for which many lack staffing to cover. With current budget shortfalls, many may be less likely to directly participate in the future. QuadState and its three member counties from California were granted intervener status in the current litigation regarding the West Mojave, and we are participating with the Federal defendants on the case.

We remain concerned on several elements of the Recovery Plan revision, and hope the Fish and Wildlife Service addresses at least some of them, but will await release before reacting and commenting on what may or may not be in that document.

Regarding the Sonoran Population, Mohave County asked that we become engaged in the review regarding the petition to list, which is under FWS consideration at the present time. We have engaged the wildlife agencies regarding data and information so as to assist Arizona counties in responding to the petition. The addition of La Paz County to our organization is a direct result of the petition process and its desire to engage in the process in advance of decision-making. We have made other counties in Arizona aware of the petition.

We [the counties] look forward to developing partnerships and interface with the Arizona agencies and interagency organizations, and to continuing our relationship with the agencies in California, Nevada and Utah, so as to provide local governments with information; and to provide the agencies with local government's perspective on issues, policies and information.

The Desert Tortoise Conservation Center: A New Story

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In March 2009, the San Diego Zoo's Institute for Conservation Research, as a member of the Conservation Centers for Species Survival (C2S2), entered into a cooperative agreement with the US Fish and Wildlife Service (FWS), the Bureau of Land Management (BLM), and the Nevada Department of Wildlife (NDOW) to take over operations of the Desert Tortoise Conservation Center (DTCC) in Las Vegas, Nevada. Our main goal at the DTCC is to play a role in the conservation of the Mojave Desert ecosystem, including the recovery of the desert tortoise. To that end, the San Diego Zoo and its partners are changing the role of the DTCC from that of a transfer-and-holding facility to one that will support range-wide recovery efforts for the desert tortoise through conservation research, participation in on-the-ground recovery actions, training of biologists, and public education. The DTCC staff will share details of our first year on site. We have made improvements in husbandry and veterinary care, we have conducted a variety of medical tests and performed advanced veterinary procedures, and we have given the facility a face lift. In addition, we have gained community support through a volunteer/intern program, and we have conducted public education to improve the captive care of pet desert tortoises and to discourage people from removing wild desert tortoises from their native habitat. We have also established research protocols for translocation of desert tortoises back to the wild, and we are working with local agencies and organizations to collaborate on projects to improve the lives of desert tortoises everywhere. We are pleased to share the news with the desert tortoise community that the DTCC will soon have a new story to tell; one in which we can ensure that wild desert tortoises beat the odds and win the race to survive.

Tortoises Through the Lens (TTL): A Community-based Approach to Conservation

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Tortoise Through the Lens, TTL, is a community-based conservation action project; empowers high-desert youth by teaching them ecology, biology, and photography and guides them throughout the Mojave to photograph its beauty and species. The project is centered on the desert tortoise, so that the students can gain a deeper understanding of this desert icon and its plight, and can use their art towards conserving this threatened reptile.

The 20-minute presentation will consist of: 1) an introduction to the program, including how and why the program was developed; 2) how education can complement capacity building for youth; 3) what successes and lessons learned can be used to involve and engage non-traditional allies into conservation action; and 4) future efforts for TTL. The format will be a PowerPoint presentation, narrated by David Lamfrom. The presentation will also feature a photo gallery of some of the student’s best work. Five minutes will be provided at the end of the program to allow for questions.

Timing is Everything for Renewable Energy

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Work on the 52 solar projects and 54 wind energy projects proposed for public lands is focused on applications seeking federal stimulus funding and on essential transmission line projects. These include nine solar projects, five wind energy projects, three geothermal projects and three transmission lines in the California desert. Most of these are located within desert tortoise habitat. The filing of so many applications in a short period of time created an unanticipated workload for all federal and state permitting agencies, and for the public utilities. Biological consultants, including desert tortoise experts, are stressed.

Conservation of existing habitat for the desert tortoise is a primary issue for nearly all renewable energy projects. An unprecedented amount of detailed information is being received. Many sites have had surprises, ranging from the finding of zero tortoises to the finding of nearly a hundred tortoises to the finding of 3,000 year old tortoise bones.

Relocation or translocation of tortoises from the development sites poses many difficult problems. Given that disease testing, surveys of recipient sites and extensive monitoring may be necessary, how can the tortoises be moved so that the project is "shovel ready" by December 2010? Should tortoises be moved in the fall or in a low rainfall year when little food is available?

The time frame to meet the funding deadline has led to high risk for the energy companies and great uncertainty on how to proceed. Desert tortoise mitigation and compensation issues remain as major obstacles. Substations and transmission capacity may not be available at the time the power plant is ready to start production. The federal bureaucracy is not well equipped to provide timely review. Renewable projects not on the fast track may experience significant delays in review of their plans, even though they may have a superior technology or may be located in places without desert tortoise habitat.

Shifting priorities, infeasible deadlines, lack of experienced staff and mounting opposition from many sources have created a chaotic scenario for biologists attempting to provide a thoughtful and reasoned approach to analysis of the project impacts on the desert tortoise. Regional planning is following, rather than leading, the review of projects. Decisions on the fast track projects will precede the federal Solar Energy Environmental Impact Statement and the California Desert Renewable Energy Conservation Plan. The analysis of cumulative impacts is particularly difficult. For example, preclusion of connectivity linkages between critical habitat units is a possibility.

Despite these challenges, agency biologists have a commitment to "do it right" and to suggest modifications that will conserve essential desert tortoise habitat for the long term. The public interest in conservation of wildlife, including the threatened desert tortoise, is equal to the public interest in achieving energy independence.

PG&E's Renewable Energy Program: Our Approach to Meeting the Challenge

Glen Lubcke, Senior Land Planner, Land and Environmental Management

Pacific Gas and Electric Company

Pacific Gas and Electric Company (PG&E) is the largest investor owned utility in California. There are approximately 20,000 employees who carry out PG&E's primary business—the transmission and delivery of energy. The company provides electricity and natural gas to about 15 million people throughout a 70,000-square-mile service area in northern and central California. Like all utilities in California, PG&E is working towards increasing its renewable energy portfolio and PG&E's portfolio is one of the cleanest in the nation. In our efforts to become an environmental leader, PG&E is actively engaged in many efforts of renewable energy exploration and acquisition in the western Mojave Desert. Examples of our efforts and involvement with renewable energy in the Mojave Desert include:

- The tracking and monitoring of privately-owned renewable energy plants that allow PG&E to sign Power Purchase Agreements (PPAs);
- Participation in regional planning efforts to develop Best Management Practices for the draft Desert Renewable Energy Conservation Plan Best Management Practices & Guidance Manual: Desert Renewable Energy Projects;
- Participation and involvement with the Renewable Energy Action Team (REAT);
- Tracking, monitoring, and participation of the BLM programmatic EIS for renewable energy on public lands;
- PG&E is actively involved with many stakeholder groups that include solar, energy, and environmental groups with a focus on coming up with practical solutions to minimize impacts on the environment;
- Participation with the California Transmission Planning Group to track and monitor the regional planning efforts for transmission lines and renewable energy generation; and
- Participation and involvement with RETI (Renewable Energy Transmission Initiative).

SCE Leading the Way in Renewable Energy

Milissa Marona, Project Manager

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If we equate kilometers to kilowatt-hours, then Southern California Edison (SCE) is the Lance Armstrong of renewable energy buyers. SCE buys more energy from renewable resources than any other utility in the U.S. About a hundred miles separate the Tehachapi wind farms from the Los Angeles basin. That's about two hours on the highway. Well, electricity needs a special super highway to travel on, and SCE is proposing to build it.

STUDENT PAPER: ORAL PRESENTATION AND POSTER

Bolson Tortoise (*Gopherus flavomarginatus*) Headstart in New Mexico, 2009

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Restoration of the endangered bolson tortoise (*Gopherus flavomarginatus*) in the United States is dependant on captive breeding and headstarting of young. Bolson tortoises presently occur in the wild only in a small region of the Chihuahuan Desert in Mexico; an area less than 100 miles across its broadest point (Tennesen 1985, Bury et al. 1988). Three known populations of bolsons now exist in the United States, two on

Turner ranches located in southern New Mexico, and 1 in a zoo setting located at the New Mexico Living Desert Zoo and Garden State Park near Carlsbad. Twenty five live on Turner's Armendaris Ranch and 38 juveniles live on Turner's Ladder Ranch. In 2009, 25 hatchlings were produced; 13 on the Turner ranches and 12 in Carlsbad. Since the transfer of the adults from the Appleton ranch in Arizona in 2006, various techniques have been used to increase the production of neonates, which eventually will be introduced experimentally into the wild to assess their survival. X-rays have proven to be particularly useful because they not only tell us the number of eggs each gravid female has, but also an estimated time of laying. On the Armendaris ranch during the summer of 2009, 10 females were x-rayed 4 times during the nesting season (May-July). Ninety percent were determined gravid for the first clutch and 70% for a second clutch. No females produced a third clutch. Two graduate students surveyed two 8.5 acre enclosures twice daily throughout the nesting season to locate natural nests; success was limited. Nests found were either protected with an 18x16in wooden box and 2x2ft chicken wire apron predator-proof enclosure or eggs were removed for indoor incubation. Three tortoises hatched as laid in one of these enclosures. X-rays determined 84 eggs total from gravid females on the Armendaris. Among these eggs, only 27 (32%) were located in the fenced enclosures. Of the 27 eggs, 19 (70%) were removed for artificial incubation and 8 (30%) were incubated naturally. Time of indoor incubation from eggs hatching ranged between 72–80 days and natural incubating ranged between 100–110 ±5 days. By this and similar field experiments, we will continue to refine techniques to obtain large numbers of hatchlings for future releases in the wild.

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Conservation Challenges of a Desert Tortoise Population at the Edge of its Range

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The Red Cliffs Desert Reserve (Reserve) is located in southwestern Utah at the northeastern extent of the tortoises range. The Division of Wildlife Resources has been monitoring tortoises in the Reserve since 1997. Population monitoring in 2009 indicates a population decline of tortoises throughout the Reserve since 1997. In 2003, an increased number of tortoises with clinical signs of URTD were observed along with an increased number of adult shells. In the summer of 2005, approximately 14,471 acres burned within the Red Cliffs Desert Reserve. The Reserve is considered a highly threatened population due to its proximity to urban growth, small size, as well as human and stochastic threats (e.g., recreation, fire, disease, drought). We will discuss challenges that land managers face when managing a tortoise population at the edge of its range.

California's Fading Wildflowers: Lost Legacy and Biological Invasions

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Spanish explorers in the late 18th century found springtime coastal California covered with spectacular carpets of wildflowers. Nineteenth century botanists and naturalists describe flower fields across the central valley and interior southern California. Annual newspaper reports of identifiable sites such as Riverside (1885-1905) and the "Alter of San Pasqual" (Pasadena, 1885-1920), and "circle tour" localities (1920-2005) including the Arvin flower festival, Antelope Valley, Coachella Valley and Inland Empire, reveal that interior wildflower fields survived into the mid-20th century. California wildflowers were the basis of floral societies and the foundation of the New Year's Rose Parade in Pasadena. Summer coastal pastures, which were extensively burned by Native Americans, were not "grasslands" as translated from the original Spanish, but "*pasto*" and "*zacate*," interchangeable words that mean forage good for livestock. Spanish, Californio and early American settlers alike describe the California interior in the dry season as "*esteril*" or "barrens," an observation of desiccated and disarticulated native forbs that left little dry biomass.

Invasive annual grasses and forbs from the Mediterranean Basin and Middle East have devastated this nearly forgotten botanical heritage. Franciscan exotics *Brassica nigra* and *Avena fatua* had extensively displaced coastal forbfields by the Gold Rush, but flower fields in inland valleys and plains were displaced a century later by *Bromus madritensis*, *B. diandrus*, and *A. barbata*. Invasives such as *Erodium cicutarium, E. moschatum* and the clovers of *Trifolium and Medicago* coexisted with native forbs, while *Malva parviflora* and *Hordeum murinum* were limited to areas of chronic disturbance. Defenders of the perennial bunch-grassland (*Nassella)* model as the aboriginal vegetation baseline—a hypothesis deduced using space-for-time substitution by Fredrick Clements—built their case on "scientific" evidence that began in the mid-19th century. However the first botanists saw already widespread exotic grasslands, a classic case of the "shifting baseline syndrome"—the story being told is dependent on the baseline of choice. In this story, bunch grassland is assumed to have been replaced by exotic annuals due to overgrazing, but 19th century writings clearly show that bunch grasses were not important to the vegetation and that invasive species spread across California, far ahead of grazing. California wildflower pastures were displaced by invasive species without disturbance. The invasive species—fire feedback hypothesis in coastal California is refuted in view of Crespi's remarkable account (1769) of Native American burning in indigenous fuels, but merits consideration for interior barrens now covered with cured

exotic annual grassland. The role of grazing should be viewed in geological time scales because the evolution of the California flora coincided with diverse megafauna that exerted a cattle-like disturbance until the end of the Pleistocene. Packrat middens document that wildflowers have been part of California's heritage as conspecifics since at least the last glacial maximum, perhaps long before.

The wildflower flora was less affected by invasive species in the California deserts. The only widespread introduced species from the Franciscan mission period was *Erodium cicutarium* which likely spread across southeast California in the late 18th century. Descriptions of *Erodium cicutarium* coexistence with wildflowers by John C. Frémont and other mid-19th century naturalists and botanists in the central valley suggests that similar coexistence may have existed in the deserts. Wildflowers were described in the Mojave Desert by Frémont in the 1840s, and the early 20th century in local newspapers including reports of "circle tours" in the Los Angeles *Times* despite the rapid expansion of *Schismus barbatis* across the desert in the 1940s. While *Bromus rubens* first proliferated across coastal California in the 1890s, it was collected extensively in the Mojave Desert only by the 1930s, and did not become abundant until heavy rains fell from 1978 to 1983, the wettest 6-year period in instrumental records in southern California. After wet years vast carpets of red brome from 1978 to 1997 carried extensive fires (ca. 10,000 ha) and suppressed wildflowers. Dry years failed to produce good blooms. Extreme drought in 1989-1991 in the Sonoran Desert, and 1996-1997 in the Mojave Desert resulted in brome "crashes." Mass germination with the first fall rains was followed by mass mortality before reproductive maturity due to poor follow-up rains, destroying both grass cover and the seed bank. Unusually productive *Schismus barbatis* carried fires after wet years in the Coachella Valley in the 1990s. *Bromus rubens* survived best above 1200 m in western Joshua Tree National Park where it contributed to an 18,000 acre burn in 1999, a year after heavy El Niño rains in 1998. Since the 1990s wildflower blooms have again splashed across the desert, where brome has been extirpated at regional scales or greatly diminished. Historically unprecedented extreme drought produced another brome crash in 2002 (no rain fell in many areas of the desert for an entire year) was followed by a "once in a lifetime" spring bloom in 2005, after the wettest winter in instrumental records. Extraordinarily productive wildflowers (1-2 tons ha^{-1}) and native grasses (*Aristida*, *Hilaria*) fueled extensive fires in the NE Mojave Desert, eastern San Bernardino Mountains, and Joshua Tree National Park in 2005 and 2006 (60,000 ha). Fires are seldom fueled by *Brassica tournefortii*, which first proliferated in the lower deserts in the late 1970s, because its flammability is diminished by its coarse stem structure and open arrangement of stems compared to grasses. Once dry, stems also tumble with the first high winds. The future of the California deserts may be one of periodic invasion of brome after wet years and their replacement by native wildflowers after drought. Reconstruction of earthquake history along the Garlock fault near Mojave, using C-14 dates of charate, reveals that fires had infrequently burned creosote bush scrub over the past 7000 years of the Holocene. The desert was not "fire proof" before the arrival of invasive species.

California's wildflower heritage has been overlooked because of a flawed hypothesis that bunch grasses were pervasive in the past. We take for granted the rapidly fading wildflower heritage because the perception of past vegetation among the scientific community and the public has been built upon this erroneous premise. This bunchgrass story has canalized us to perceive California ecosystems in a certain way, preventing us from observing, doubting, and searching for alternative evidence to construct alternative stories. California invasive grasses and forbs are productive and aggressive not because of intrinsic life traits, but because they are New World "goats on islands," without their Old World pathogens. The restoration of California's wildflower flora will require management strategies involving the entire landscape, with a historical perspective. Potential avenues for effective management and conservation include spring burning, seasonal grazing by domesticated livestock, and use of Old World pathogens as biological controls of California's invasive annual species.

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Head-starting Desert Tortoises at the Twentynine Palms Marine Base: 2009 Update

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The Desert Tortoise head-start hatchery-nursery facility at the Twentynine Palms Marine Base was established to research head-start methodology, including vertical transmission (mother to egg) of *Mycoplasma*-based disease (URTD). This question was abandoned following three years of unsuccessful location of wild females having clinical (visible) symptoms of URTD or positive ELISA or PRC tests, but several other questions are being studied. In collaboration with Dr. R. Murphy, we found that the incidence of multiple paternity within egg clutches is high, similar to earlier results from Edwards AFB. Since hatchling sex is determined not by their genes but by incubation temperature, we wondered whether something about the head-start facility may have influenced nest temperatures and thus the sex ratios of hatchlings. Dr G. Kuchling used endoscopy to determine the sex of about 30 juveniles each from 2006, 2007 and 2008 cohorts at TRACRS, and found that from 66% to over 95% of cohorts were females. Results to date are insufficient to test for a significant trend over time. Since 2006, hatching success, survivorship from hatchling to yearling, and survivorship from yearling to three years old have all been between 70 and 90 percent. Analyses of growth rates suggest that most juveniles hatched in the TRACRS facility, which receives supplemental "rain" to prolong growth of food plants, are growing about three or more times faster than do juveniles in "control" enclosures that get only natural rainfall. Projections of these growth rates suggest that these juveniles may reach releasable size (estimated to be about 110 mm MCL) after a minimum of about seven years.

Shell Hardness Index and Rate of Shell Hardening in Desert Tortoises

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Heavy predation on hatchlings and juveniles of the threatened Desert Tortoise is apparently a major impediment to recovery of the species in the Mojave Desert. The shell of hatchlings remains soft and flexible for years, and hardening of the shell, along with increased size, is thought to improve predator resistance greatly. We used a tension-calibrated micrometer to measure shell hardness of 158 young tortoises with ages ranging from one to 17 years, from three desert sites in California. Shell Hardness Index (SHI) values exhibited considerable variation within age cohorts, and adjusting for size (MCL) variation within age cohorts did not reduce this variation in SHI. Shell hardness increased asymptotically with increasing age and increasing size. Juveniles having access to an extended supply of green desert annual plants due to experimental rain supplementation grew faster but exhibited softer shells than control (natural rainfall only) tortoises during their first year (but not in subsequent years) of life.

Conservation Activities to Benefit the Desert Tortoise: Educational Outreach, Land Management, and Habitat Improvement

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For the last 36 years the Desert Tortoise Preserve Committee, Inc. (DTPC) has focused its desert tortoise conservation and recovery efforts through educational outreach, land acquisition, active land management, and more recently, habitat improvement. Success in the campaign for the recovery of the desert tortoise can only result from these types of on-the-ground actions.

Last year approximately 10,000 people were contacted via educational presentations, public outreach events, and through contact with the Interpretive Naturalists staffed at the Desert Tortoise Research Natural Area (DTNA). Each contact helped spread the important message of conservation throughout the range of the imperiled desert tortoise.

The DTPC was awarded $89,000 in grant funding from the Off-Highway Motor Vehicle Recreation (OHMVR) Division for two ground operations projects in 2009. The bulk of the funding ($68,000) will be used to install desert tortoise exclusion fencing along three miles of the DTNA's boundary fence. The dramatic increase in traffic on roads near the DTNA necessitates this protective fencing. The remainder of the funding ($21,000) will be used to replace vandalized and weathered signs, sign newly fenced areas, and provide additional directional signage at major intersections near the DTNA.

The entrance to the DTNA, badly damaged by off-roading activities in recent years, was fenced in 2009. This fencing will prevent future impacts from vehicle trespass and allow the habitat in the area to recover naturally. The fencing also serves to make the entrance of the Natural Area more attractive to visitors.

The long-term goal of completing desert tortoise exclusion fencing along Harper Lake Road was accomplished in December of 2009. The DTPC's Harper Lake Road Fencing Project is the result of a successful multi-agency effort to ensure compliance of mitigation conditions under federal and state permits. The DTPC assumed fencing and monitoring commitments made by Luz Solar Partners Ltd VII and IX whose permits for the protection of the desert tortoise and its habitat were in default. But for the DTPC's role in fencing and monitoring Harper Lake Road, the road and impacts associated with the solar plant built in the 1980s would not have been mitigated.

The DTPC continued to focus heavily on improving the habitat at Camp "C". The five acres of habitat improvements (i.e. vertical mulch, horizontal mulch, and catchments) constructed in 2007 were regularly watered and monitored throughout the year and new practices were conducted on an additional 7.5 acres. The current status of the project and plans for an additional 17.5 acres of habitat improvement will be discussed.

The Pitfalls of Using Test Results for Decision-Making in Conservation Programs.

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The importance of disease risk assessments and disease screening for reintroduction and translocation programs is universally accepted and comprehensive tools are now available to guide the process. However, the traditional approach of developing a list of diseases of concern, testing release candidates for those diseases, and making release decisions based on the test results suffers from several fundamental problems. These problems are best illustrated by looking at two common scenarios where test results are used for decision-making in translocation and reintroduction programs.

The first scenario occurs when a population of apparently healthy animals is being screened to identify disease carriers, or those in the early (asymptomatic) stages of disease, so they can be *excluded* from a release cohort. It is important to understand that most diagnostic tests are designed to detect an infectious agent (or the host response to an agent) in an animal showing clinical signs of disease. Diagnostic tests that have been validated for the host species in question will generally perform well in this situation, because animals with clinical signs are the ones most likely to have the disease agent. However, when the very same tests are applied to animals without clinical signs, as in our first scenario here, test performance will decline significantly (because animals without clinical signs are the ones least likely to have the agent). Poor test performance will be manifested as a high proportion of false positives in this situation, leading to misclassification errors that not only exclude valuable individuals from translocation programs, but sometimes result in euthanasia of perfectly healthy animals.

The second scenario occurs when a mixed population of healthy and diseased animals is being tested to verify that the apparently healthy individuals are test-negative (truly disease-free), so they can be *included* in a release cohort. Test performance will also be poor in this situation, but will be manifested as a high proportion of false negative results. This leads to misclassification of infected animals as uninfected, and therefore to the unintentional release of diseased individuals into the wild.

Additional problems occur when surveillance is only conducted on the source population. To adequately evaluate the risk posed by the presence of an agent in the source population, one needs to know whether the agent is also present in the destination population. However, it is seldom feasible to sample sufficient numbers of animals in the field to answer this question, and the same interpretive problems with surveillance tests described above would apply.

Using test results for decision-making in conservation programs requires a thorough understanding of these pitfalls and the tailoring of surveillance programs to the specific populations and questions at hand.

Arrival and Spread of *Brassica tournefortii* in Southwestern North America

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Brassica tournefortii ("Sahara mustard") has become an abundant annual weed in open dry areas, especially in sandy soil, through much of southwestern North America. In less than 90 years it is spread from an initial point of establishment in the Coachella Valley in Riverside County, California, to points as far distant as the Central Coast Range of San Benito County, California, El Paso, Texas, and the coast of southern Sonora, Mexico. It has also found its way into southwestern Utah and is continuing to spread north in the Coast Range and San Joaquin Valley of California. So far it is unrecorded from Inyo County, California. It now occupies an area that stretches some 1460 km NW to SE and c. 1300 km east-west. Yet, it has not stopped its spread, though in some areas it may have reached ecological limits.

Natural and Induced Antibodies in Experimentally Immunized Desert Tortoises (*Gopherus agassizii*): The Importance of Season and Gender

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Captive desert tortoises were immunized with ovalbumin (OVA) in Ribi's adjuvant to induce a humoral immune response, both before and after hibernation. We observed a significant mean increase in OVA-specific antibody, and a gender-by-season interaction in the ability of desert tortoises to make an induced immune response. We observed relatively high levels of pre-existing natural antibody to OVA in all tortoises, and levels varied among individuals. There was a significant, negative relationship between an animal's natural antibody titer and the maximum increase in induced antibody titers, and a significant, positive relationship between the magnitude of long-term elevations in OVA-specific antibody titers and the maximum increase in induced titers. Both natural and long-term elevations in induced antibody titers may be important elements of the tortoise immune system, with possible influences on the ecology and evolution of host-pathogen interactions. Reliance upon natural antibodies and the persistence of induced antibodies may be an adaptation in reptiles to defend themselves from pathogens in spite of their slow metabolic rates. In addition, natural and persistent antibodies may impact the interpretation of serological assays.

STUDENT PAPER

Digging Deeper: An Examination of Invasive Species and Nitrogen Deposition Effects on Aboveground Annual Forb Communities and Seed Banks in the California Deserts

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Invasive species pose a threat to natural communities around the globe. In southern California, desert ecosystems are experiencing altered nutrient cycles, increased fire frequency, and competitive effects from invading annual plants. Anthropogenic nitrogen deposition adds to the problem by artificially fertilizing the desert's low nutrient soils and creating a favorable environment for invaders. This degradation of habitat not only affects the vegetative community, but also the animals, such as the desert tortoise, that rely on it. In two related studies, we investigated the effects that invasive annual species and nitrogen deposition have on the aboveground community, as well as how that translates to the soil seed bank. A field study in the Colorado Desert using invasive removal and nitrogen additions demonstrates that both natives and invasives can respond positively to nitrogen additions, however invasive removal is required for natives to

obtain maximum benefits. A seed bank study at Joshua Tree National Park in sites fertilized with nitrogen shows that while nitrogen can have significant effects on the aboveground community, this is not always evident in the soil seed bank. It does, however, elicit important differences between sites, suggesting that factors such as background nitrogen deposition, soil rockiness, and historic levels of invasion may play an important role in seed bank composition. This work has important implications for conservation efforts, as well as emissions legislation. Understanding the combined effects of invasive species and nitrogen deposition on the desert landscape will help to create a more complete picture of how and why natural lands are being altered.

Desert Tortoise Recovery Efforts and Plans at Mojave National Preserve

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Mojave National Preserve encompasses 772,463 acres of designated habitat for desert tortoise (*Gopherus agassizii*) in the Fenner and Ivanpah valleys. In November, 2009 Chevron Inc. began removing the waste water pipeline from the Molycorp Mine site to former evaporation ponds on the Ivanpah dry lake bed. As part of the mitigation effort, Chevron is constructing a facility for research into juvenile headstarting as recommended in the Revised Recovery Plan Implementation Schedule section 3.3. An interagency panel of experts will select one of three highly qualified research groups to undertake this 15 year study. The primary criterion for selecting a research team is the potential to promote recovery of the species. An equally high priority is the ongoing mortality of tortoises along the 140 miles of paved roads through designated habitat. In the spring of 2009 we hired a contractor to conduct transects along Morningstar Mine Road and Essex Road following the methodology of Boarman and Sazaki (1996). Preliminary analyses suggest a population depression extends beyond 1.5 km from the edge of the road. We have requested funding for fencing critical highway sections. Our observations of traffic indicate that the roads connecting Las Vegas with populated areas to the south carry more traffic at a higher speed than other roads. Drivers on these roads have a 4% likelihood of spotting a tortoise in the road and warning signs appear to have no effect. Mojave National Preserve is continuing desert tortoise outreach and education efforts in partnership with the Desert Managers Group.

Desert Managers Group

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The Desert Managers Group (DMG), an organization of federal, state, and county land managing agencies in the California deserts, focuses on coordinating and integrating desert tortoise recovery actions and monitoring efforts among managers and scientists across jurisdictional boundaries. A key to desert tortoise recovery is an informed public that understands and appreciates desert tortoise recovery. Now in its fourth year, the DMG is partnering with non-governmental organizations to continue its desert tortoise education program. Some goals of the program include standards based environmental education, brochures targeting specific audiences or topics, and media releases. The DMG is also coordinating ongoing regional assessments and science with renewable energy permitting plans such as the Desert Renewable Energy Conservation Plan and the Bureau of Land Management's Solar Programmatic Environmental Impact Statement.

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

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Since 1939, state laws have been in place in California to protect the desert tortoise. In August of 1989, the tortoise was officially listed by the Fish and Game Commission as threatened under the California Endangered Species Act (CESA). Sections 2080.1 and 2081 of the Fish and Game Code permit take for scientific, educational, management, or incidental take to an otherwise lawful activity provided the take is minimized and fully mitigated. In addition to an Incidental Take Permit, a Memorandum of Understanding (MOU) for Handling Tortoises is needed, and we must review the qualification of each person who applies for the MOU. The Department also issues Scientific Collecting Permits and MOUs for research and studies on desert tortoise; and permits for possession of Captive Tortoises.

The Department, through the CESA permitting process, and by other means, continues to acquire lands within recovery units. Along with the land acquired, the Department has also collected enhancement and endowment fees for management of the lands. Fencing has been installed in some areas to exclude cattle grazing and off-highway vehicle use. In addition to the lands that have been acquired by the Department, mitigation lands have also gone to the Desert Tortoise Preserve Committee.

In 2009, the Department spent significant time and resources on renewal energy projects. Work continued on permitting numerous small projects, which include mining activities, housing and other urban development, and road projects. The Department also spent considerable time again this year working with Department of Defense on the Fort Irwin Expansion, reviewing mitigation lands, working to with the Fish and Wildlife Service to update the Desert Tortoise Handling Guidelines, permitting desert tortoise research projects, improving our methods for dealing with captive tortoises and working on subgroups of the Desert Managers Group on management and protection of the desert tortoise in California.

Fire and Invasive Species Impacts on Native Desert Annuals: Causes for Concern and Opportunities for Recovery

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Exotic annual species, like *Bromus* spp., *Schismus* spp., and *Erodium cicutarium*, have invaded low elevation creosote bush scrub in California and other portions of the American southwest. Exotic grasses, in particular, have exerted a strong influence on this vegetation by increasing the frequency and extent of fire, a disturbance that was historically very infrequent (Brooks and Esque 2002, Brooks et al. 2004). Sites that have been burned show little resiliency as dominant perennial species appear poorly adapted to fire (Brooks and Minnich 2006, Abella 2009). The impact of fire on native desert annuals is less understood (Brooks 2002). We were interested in the following questions pertaining to fire and annual plants; how does fire effect invasive and native annual species composition; how long do these impacts last for; and what is the impact of repeated fire? These questions were addressed by examining a series of burned creosote bush scrub stands from western Coachella Valley that ranged in time since fire from 3 to 29 years ago. In addition, a site containing portions unburned, once-burned, and twice-burned were also investigated. We found that shortly after fire, invasive species like *Erodium cicutarium* and *Schismus* spp. are promoted by fire while *Bromus madritensis* ssp. *rubens* and native annual species decline. Fires decreased native annual species richness, which was detected in burns ranging from 3 to 21 years old. The impact of repeated fire was especially severe, with decreased species richness occurring each time a stand burned. In general, fire promoted invasive annual plants and negatively impacted native annuals.

To tease apart the difference between fire impacts and invasive annual interference on native annual plants, invasive plant removal treatments were implemented in burned and unburned sites. Regardless of fire history, invasive species removal dramatically increased native annual species abundance and richness. Then, when comparing invasive removal plots in a burned site with invasive removal plots in an unburned, relatively “pristine” site with high regional species richness, the burned site exhibited native annual plant abundance and species richness equal to or greater than the “pristine” site. These results imply that native annuals, collectively, are highly resilient to fire if invasive species are not present. In other words, the general decline in native annual species richness that is common in creosote bush scrub after fire is more attributable to invasive species competition rather than from fire itself. Competitive interference from invasive annual species appears to be a great threat to native annuals in both burned and unburned creosote bush scrub. Lastly, our invasive plant removal treatments revealed that a post-emergent herbicide, Fusilade II, is effective at killing both exotic grasses and *Erodium cicutarium* with minimal nontarget effects. If applied with discretion, this product appears to show promise as a valuable tool in the battle to control invasive species in desert landscapes.

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Response of Desert Tortoise Habitat, Populations, and Individuals to the 2005 Southern Nevada Complex Fire in Lincoln County, Nevada

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The Southern Nevada Complex fires of 2005 burned thousands of acres of desert tortoise (*Gopherus agassizii*) habitat in Lincoln County, NV. In 2008 and 2009, we assessed vegetation characteristics at burned and unburned sites by measuring shrub and herbaceous density, species richness, gap intercept, line-point intercept, and herbaceous production. Line Distance Sampling Transects were added in burned and unburned areas as well. Additionally, GPS transmitters were affixed to tortoises near the burned area to efficiently track individual movements. A variety of vegetation characteristics with consequences for desert tortoises differed in burned vs. unburned sites. Overall, species richness of plants palatable to desert tortoises was significantly lower at burned sites. Additionally, an increase in the percent cover and production of all herbaceous plants was observed at burned sites. While this suggests an increase in the quantity of food available to tortoises after fire, much of the increase is likely driven by one exotic forb, *Erodium cicutarium*, which was most prevalent at burned sites. Conversely, species richness and density of native plants, some of which are consumed by desert tortoises, were lower at burned sites. Finally, both species richness and percent cover of shrubs were lower and the spacing of shrubs was higher, at burned sites, which could have impacts on desert tortoise thermoregulation. Line Distance Sampling transects in burned and unburned

areas observed only ~2% of tortoises in burned areas. GPS data indicate tortoises in this study are using burned habitat and ~47% of tortoise home-range areas were burned.

An Introduction to the IUCN Red List of Threatened Species, and its Application to the Desert Tortoise

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This presentation will give a quick overview of the aims of the IUCN Red List of Threatened Species, the criteria determining a species' assessment, the assessment process, and the wider implications of Red List status, using the Desert Tortoise as an example. Much more detail than can be provided in this presentation is available at http://iucnredlist.org, particularly http://iucnredlist.org/technical-documents/categories-and-criteria and http://iucnredlist.org/technical-documents/assessment-process.

The Desert Tortoise (*Gopherus agassizii*) in Mexico, Project Update

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Approximately 40% of the desert tortoise's (*Gopherus agassizii*) geographic range is in northwestern Mexico, yet little is known of the species south of the border. Starting in 2001, we initiated collaborative international efforts involving researchers, agencies, tortoise field biologists, and local citizens to acquire baseline data on tortoise ecology, status, and conservation biology in Mexico. In 2001-2002 we documented a major mortality event on and near Tiburón Island. In 2005-2006 we sampled near Alamos (tropical deciduous forest,TDF), Hermosillo (Sonoran desertscrub), and Obrégon (foothill thornscrub), capturing 63 tortoises, as well as telemetering 19 in the TDF. Disease analysis, which also included 22 captive tortoises, indicated that all but one of the wild tortoises were negative for *Mycoplasma*, whereas 17 of the captives were positive or suspected positive. During 2007-2009, we maintained telemetric monitoring at Alamos. We continued extensive sampling during 2008 and 2009, focusing in Sinaloa where the currently known southern range limit (Topolobampo, Sinaloa) is found, and on the genetic-morphological-ecological transition zone in eastern and southern Sonora. There is concordance of morphology and genetics with the subtropical (desertscrub plus thornscrub) - tropical TDF transition, but these concordances appear imperfect and potentially complex. We found 39 additional tortoises, and still remain to clearly confirm the presence of *Mycoplasma* and related disease in the wild in Mexico. Based on 16 microsatellite loci and ~1200 bp of the mitochondrial ND4 gene, we identified two genotypes in Sonora; one in desertscrub and thornscrub resembling the Arizona type ("Sonoran") and a second notably associated with TDF ("Sinaloan"). Sinaloan samples showed elevated genetic variation. We estimate this Sinaloan type diverged 5-6 mya from a common ancestor with the Sonoran and Mojave lineages. Spatial overlap of several genotypes at the southern boundary of Sonoran Desert scrub may be the result of a natural species friction zone, human translocation or possibly isolation prior to the formation of the Sonoran Desert. Two key conservation problems are likely affecting this tortoise in Mexico—climate-driven mortality episodes and intensified fire regimes associated with type conversion from native vegetation to Africanized buffelgrass pasture. The Tiburón mortality episode was associated with drought, as also observed in southern Arizona Sonoran Desert. Although precise causes of such episodes remain to be rigorously demonstrated, apparent associations with heat and drought foreshadow tortoise declines if current climate change predictions prove correct. We have limited observations of tortoises in buffelgrass-thornscrub landscapes, but plan to expand upon published observations suggesting that type conversion may decimate tortoise populations.

Antigenic Variation in *Mycoplasma agassizii* and Distinct Host Immune Antibody Responses Explain Differences Between ELISA and Western Blot Assays

Lori D. Wendland[1], Paul A. Klein[2], Elliott R. Jacobson[3], and Mary B. Brown[1]*

Departments of Infectious Diseases and Pathology[1] and Small Animal Clinical Sciences[3], College of Veterinary Medicine and Department of Pathology, Immunology and Laboratory Medicine, College of Medicine[2], University of Florida, Gainesville, FL 32611

Due to the precarious status of desert (*Gopherus agassizii*) and gopher (*G. polyphemus*) tortoises, conservation efforts typically include health assessment as an important component of management decision-making and often may be the determining factor for translocation of animals. Mycoplasmal upper respiratory tract disease (URTD) is one of very few diseases in chelonians for which comprehensive and rigorously validated diagnostic tests exist. Recently, it has been suggested that the ELISA for detection of *M. agassizii* misidentified negative animals as seropositive and that Western blot analysis was a more reliable test. We present data that demonstrates that the failure to detect immunoreactive bands to *M. agassizii* strain PS6 in Western blots from selected ELISA-positive tortoises is most likely a result of the failure to use multiple *M. agassizii* strains as antigens in the Western blot.

In this study, sera and clinical isolates of *M. agassizii* were obtained from eight *Gopherus* tortoises documented at necropsy to be (i) ELISA seropositive, (ii) infected with *M. agassizii* as indicated by direct isolation of the pathogen from the respiratory surfaces, and (iii) to have histological lesions of URTD. We selected four clinical isolates of *M. agassizii* (strains PS6, 723, IR, and 262) for preparation of SDS PAGE and ELISA antigen**.** We also compared the reactivity of tortoise sera in an ELISA in which different strains of *M. agassizii* were used as antigen. Sera from tortoises were tested for the ability to recognize antigens prepared from heterologous as well as homologous strains of *M. agassizii* by both EISA and Western blot.

Serum from all eight tortoises reacted with *M. agassizii* strain PS6 when used as the ELISA antigen, but only 6 of 8 (75%) sera had strong banding patterns against *M. agassizii* strain PS6. All tortoises reacted by Western blot with SDS PAGE antigens prepared with the homologous strain of *M. agassizii*, but unlike the ELISA, reactions with SDS PAGE antigens prepared from heterologous clinical isolates varied markedly. For many mycoplasma species, detection of specific antibodies by ELISA is considered to be relatively strain-independent, whereas other assays such as Western blot, metabolic inhibition, and complement fixation assays are documented to be strain-dependent or best used for confirmation. These differences are likely explained by the location of the antigens (surface exposed, membrane or cytosolic), binding affinity to microtiter plates, degree of surface variation, biofunctional assays, and *in vivo* expression of antigens.

The ability of clinical isolates of most mycoplasma species to express different surface proteins, the variability in host immune recognition of antigenic determinants, and the need for multiple mycoplasma strains as antigens in Western blot analysis of naturally infected animals is well documented in the literature. In our study, individual variation in the immune response among animals, even to the same strain of *M. agassizii*, was common in Western blot. We observed similar heterogeneity in the response of individual animals to *M. agassizzi*, with antigens prepared from both the homologous strain recovered from the individual as well as from heterologous strains. Even in animals documented by the most rigorous methods to have current active URTD, Western blot using a single antigen failed to detect true positive animals in 25% of cases, whereas ELISA reliably detected all animals proven to have URTD.

The American West at Risk: Science, Myths, and Politics of Land Abuse and Recovery

Howard G. Wilshire and Jane E. Nielson

Email: howardgw@comcast.net

The American West at Risk: Science Myths, and Politics of Land Abuse and Recovery, speaks to rising public concerns over environmental calamities echoed in our national headlines, and offers ways to combat the damages. The text illuminates how the western United States reached a state of resource depletion, along with extensive land, water and air pollution, and species extinctions. Especially in the Western U.S., land misuse and overuse have created a serious crisis.

Southern California suffers from multiple legacies of land abuse, principally misguided grazing and farming practices, military training, reckless urbanization, unbridled mechanized recreation, and exploration for and exploitation of energy and metallic minerals. Massive wastes--the nation's number one product--either created in the desert or disposed of there, include Cold War pollution from both training and weapons tests, both radioactive and not, and the urban garbage overflow. After describing the book's origin, purpose and objectives, we will detail the rapidly accelerating threats and potential consequences of locating utility-scale solar and wind power plants in our deserts, and discuss the best alternatives.

Wilshire, H.G., J. E. Nielson, and R.W. Hazlett. 2008. The American West At Risk: Science, Myths, and Politics of Land Abuse and Recovery. Oxford University Press, Inc. New York, New York. 619 p.

Department of Defense and Desert Tortoise Conservation

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Military installations face many challenges just as other land management agencies. Desert tortoise (*Gopherus agassizii*) populations continue to decline on military bases. Predation by common ravens, coyotes, and domestic dogs has an effect on desert tortoise populations. Military bases must employ ecosystem management principles and manage their lands for multiple uses and military missions. Department of Defense (DoD) installations in the western Mojave Desert initiated and continued many conservation programs for the desert tortoise in 2009. Conservation measures covered a broad spectrum at each installation including education and outreach, research, and other projects to manage the species and habitats. DoD installations also participated in the Desert Managers Group, associated workgroups, and the Desert Tortoise Management Oversight Group, to support recovery planning and action. Projects such as head starting are designed to increase populations and enhance recovery efforts and can be exported to areas beyond installation borders. Some of our research projects have broad applications beyond the boundaries of the military installations. Research projects include disease studies, population monitoring and demographic research, predator research, and head starting. Public outreach and education of base personnel continue to be important programs at military installations. These efforts involve presenting programs in schools, education of military and civilian workforce to supporting public outreach activities in

local communities. Desert tortoise conservation efforts involve a significant commitment of resources within our environmental offices and throughout the installations.

EXHIBIT 447

DEPARTMENT OF THE ARMY
HEADQUARTERS, UNITED STATES ARMY GARRISON
FORT IRWIN, CA 92310-5000

REPLY TO
ATTENTION OF

IMWE-IRW-PWE 2 April 2009

MEMORANDUM FOR Desert Tortoise Recovery Coordinator, USFWS Desert Tortoise Recovery Office, 1340 Financial Blvd., Suite 234, Reno, Nevada 89502

SUBJECT: Fort Irwin FISS Depredation

1. The purpose of this memorandum is to report juvenile desert tortoise depredation discovered in the Fort Irwin Study Site (FISS).

2. On 26 March 2009 Fort Irwin biologists visited the FISS to inspect the facility for potential damage caused by a high wind event 21, 22 and 23 March 2009 and to record data at comparative vegetation plots and to evaluate emergence of juvenile tortoises in Pens 2 & 3. Upon arrival at the site it was apparent the netting of the FISS had sustained damage from the high wind event. Several gaps and holes in the roof netting of both pens (composed of wire mesh and hog ring construction) were discovered. Upon entering Pen #2, two depredated juvenile tortoises were discovered. Both juvenile tortoises had large holes pecked into the dorsal surface (carapace) and their heads were missing. Further investigation found ten additional dead juvenile tortoises for a total of 12, all with heads missing but no additional carapace damage (Table 1). While conducting search transects in the enclosures, two ravens flew overhead and circled the FISS pens, vocalized, and departed. A third raven was found dead in Pen #3 where the majority of tortoise carcasses were located (Table 1). No live tortoises were observed, however, several side-blotched lizards, zebra-tailed lizards and a whiptail lizard were observed. Photos of tortoise carcasses, as they were found, are available.

3. Pens #1 and # 4 were also intensively searched for tortoises and fence damage. Neither Pen Pens sustained any visible damage to the fencing and two live sub-adult tortoises (#FW-4439 and #4522) were found healthy, active and feeding in pen #1. No tortoises were observed in pen #4.

4. No obvious signs of vandalism of the enclosures were observed. It is presumed ravens gained entry through holes in the roof created by the netting roof supports during the high wind event.

5. On March 27, 2009 three Fort Irwin biologists returned to the FISS pens to repair gaps in roof netting in pens #2 and #3. All gaps of a size that could conceivably allow a pigeon-sized animal or larger to pass through were repaired and secured. There are multiple areas of the roof netting in these two pens that continue to be of great concern in terms of

potential/future damage. These pens will be monitored/inspected every two weeks and immediately following high wind events to identify and repair any additional damage.

6. Fort Irwin POC is the undersigned at, clarence.everly@us.army.mil, 760-380-3740, for additional information or questions.

ENCL

Clarence A. Everly
Natural Resources Program Manager
Fort Irwin, CA.

Table 1. Juvenile tortoise carcasses recovered from FISS pens #2 and #3.

Tortoise #	Pen #	Northing	Easting	Signs of trauma / death
4752	3	545654	3887211	Head missing; limbs intact
4740	3	545690	3887237	Head and left front limb missing
4501	3	545689	3887220	Head missing; front limbs contorted /possibly damaged
No #	3	545650	3887209	Head missing; several scutes missing
No #	3	545673	3887224	Head missing; front left limb damaged; rear of carapace damaged with multiple small holes in carapace.
No #	2	545689	3887263	Two juveniles with heads missing; large hole in carapace; immediately adjacent to one another and in same condition.
No #	2	545689	3887263	
4636	3	545668	3887230	Difficult to determine status of head; appears to be traumatized; Hole in rear of carapace; several scutes missing.
No #	3	545668	3887230	Head and right front limb missing; several scutes missing
4743	3	545681	3887230	Head missing; right front limb damaged
5005	2	545640	3887232	Head and left rear leg missing; large hole in dorsal carapace.
4745	3	545649	3887203	Head missing; left front leg nearly severed.

EXHIBIT 448

Desert Tortoise Translocation Plan for Fort Irwin's Land Expansion Program at the U. S. Army National Training Center (NTC) & Fort Irwin

Prepared for

U.S. Army National Training Center, Directorate of Public Works

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29 July 2005

Executive Summary

The U. S. Department of the Army plans to commence military activity at the Ft. Irwin National Training Center in the Eastgate Area, the Southern Expansion Area (SEA), and Superior Valley in 2005, 2007, and 2010, respectively. We provide a timeline for activities and a list of items for which permits may be required prior to the commencement of military activities. This plan focuses primarily on issues related to translocation of desert tortoises (*Gopherus agassizii*) from the SEA. We expect that results from initial releases will help guide future translocations of desert tortoises from the Superior Valley expansion area. Therefore we expect that this translocation plan will be amended to include additional research and monitoring projects as those projects are identified and developed. The translocation plan has three main objectives: 1) To provide for safe, humane and successful translocation of tortoises from the SEA with minimal impact to resident desert tortoises (recipients and controls) at sites where translocated animals are released (translocation sites); 2) to study translocated, recipient, and control (those tortoises living near translocation areas, but whose home ranges do not overlap those of translocatees or recipients) animals to learn as much as possible about the ecology, conservation, and management of the desert tortoise (Fish and Wildlife Service 1994, Tracy et al. 2004); and 3) to define measures of success for translocation and provide metrics to evaluate success over multiple time scales, which we identify for both the short- and long-terms.

The procedures and the expected result of implementing this translocation plan were developed with consideration of recommendations provided in the Desert Tortoise Recovery Plan, and terms and conditions from the Fish and Wildlife Service Biological Opinion that evaluated effects of the expansion of the military base boundary (Fish and Wildlife Service 2004, BO# 1-8-03-F-48, March 15, 2004) in consultation with the Conservation Mitigation Working Group. This plan provides both short– and long–term metrics that can be used to assess the success translocation activities. These metrics will be addressed by specific monitoring/research projects that will be designed to address these goals in the future.

To identify and prioritize possible translocation sites, scientists from the U. S. Geological Survey (USGS), The University of Redlands, and the University of Nevada, Reno (UNR) collaborated on a Geographic Information System (GIS) decision support model. The model was based on geospatial data used in an expert-opinion decision support model describing tortoise habitat, threats to tortoises, historical tortoise abundance, and several anthropological factors that were considered to be important to the survival of tortoise populations. The model was designed such that a variety of management scenarios could be simulated with geospatial data to illustrate how different land use and management decisions affected locations under consideration as translocation sites for tortoises. The geographic range of the model covered 7946 square miles in the West Mojave Recovery Unit including three Desert Wildlife Management Areas (i.e., Ord-Rodman, Superior-Cronese, and Fremont-Kramer). This covered a rectangle bounded by the cities of Ridgecrest, Mojave, Victorville and on the east by Baker. We analyzed the output from 6 scenarios. Then we ran the model to determine which areas scored high among all six scenarios as preferred sites for translocation. We identified seven general areas that had several contiguous sections of land (>6 contiguous sections). One important conclusion that resulted from the modeling exercise and site visits is that the appropriateness of these sites for translocation is

highly influenced by whether or not Interstate-15 and other high traffic roads are fenced with tortoise proof fencing.

We provide guidance on appropriate translocation timing and procedures, and aspects of tortoise ecology and the habitat that should be studied. Most of the research identified by this plan was recommended by the Desert Tortoise Recovery Plan (Fish and Wildlife Service 1994). Desert tortoises found to be infected with *Mycoplasma* spp. (i.e., clinical sign and/or ELISA positive) may be used in research programs under strict guidelines and will be contained in quarantine facilities outside of Desert Wildlife Management Areas (DWMAs).

The general translocation area where desert tortoises in the SEA are moved to will be surveyed for the presence, distribution, health status of, and habitat use by resident tortoises. A portion of the residents will be monitored as controls and to document any effects of translocation on resident populations.

Acknowledgements

Guidance on this plan was provided by the Conservation Mitigation Working Group: Becky Jones and Glenn Black - California Department of Fish and Game; Charles Sullivan, Becki Gonzales, Roxie Trost – Bureau of Land Management; Ray Bransfield, Doug Threloff, and Roy Averill-Murray – US Fish and Wildlife Service; David Delaney and Larry Pater – CERL, Priscilla Kernek, Kimberley Rainey, Anthony Rekas, Neil Lynn, Mickey Quillman and Ray Marler – Department of the Army.

Earlier drafts of this manuscript benefited from discussions and comments from Kristin Berry, Julie Yee, Karen Philips – USGS, Mary Cablk - Desert Research Institute and Alice Karl, Jill Heaton – UNR, Larry Pater and David Delaney – ERDC/CERL, and the members of the Conservation Mitigation Working Group listed above.

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I. Introduction

When properly implemented, translocation may provide a valuable tool that can be used to minimize direct impacts to tortoises, augment natural population, or to repatriate otherwise suitable areas that have experienced local extirpations and assist in recovery (Fish and Wildlife Service 2004, Field 1999, Nussear 2004). Translocation activities also provide a forum for collecting monitoring data to determine if desert tortoises respond in a manner predicted by resource managers, and an opportunity to conduct research that yields new data that can be used to manage the species in a proactive manner. Recent research on translocation in Nevada and Utah indicated that translocated tortoises had similar levels of mortality compared to resident tortoises, and that translocated females produced similar numbers of eggs compared to resident females (Nussear 2004). Translocated tortoises in these studies initially moved further than resident animals, but adopted similar movement patterns with increased site fidelity (comparable to that of resident tortoises) after one or two activity seasons (Field 1999, Nussear 2004). Furthermore, there appeared to be no adverse effects on the resident populations into which tortoises were translocated as measured by survivorship, reproductive output, and movement patterns of residents (Nussear 2004). Thus in the short-term (3 years), translocation was deemed by the authors of these studies to be a successful solution for the disposition of displaced tortoises. However, there are still many aspects of the responses of tortoises to translocation (both translocatees and resident animals) that have not been addressed quantitatively, and warrant further investigation. For example (but not exclusively), the physiological stresses imposed on translocated and resident tortoises have not been documented and the fate of tortoises translocated into areas where natural populations have experienced significant declines (due to unknown causes) has not been investigated.

The success of translocation is typically taken to be the ability of the translocated or augmented population to become self-sustaining in the long-term (Griffith et al. 1989, Dodd and Seigel 1991, Fischer and Lindenmayer 2000). Success, however, may be measured at several temporal scales, each of which may be important precursors to judging the long-term success of a translocation program (Tasse 1989, Dickinson and Fa 2000, Fischer and Lindenmayer 2000). In the short-term (3-5 years) there may be many goals used to judge the success of a translocation program. For example, there may be some level of mortality above which a translocation study is judged to be unsuccessful (Platenberg and Griffiths 1999), it may be required that a particular release site is adopted by the translocated population (Lohoefener and Lohmeier 1986, Diemer 1984) and demonstrated by levels of site fidelity, or that the translocated animals integrate into the social structure of the existing population (Berry 1986, Reinert 1991), and translocated animals may be expected to find mates and reproduce (Berry 1986, Pedrono and Sarovy 2000).

Because the desert tortoise is a long lived species, the success of translocations must be measured over longer periods (e.g., 15 – 20 years) than the time frame of most experiments. The long-term success of translocation cannot necessarily be gauged by the same metrics typically measured in the short-term, although the evaluation of long-term success includes the success of the short-term goals. Beginning in the spring of 2005, resident tortoises will be monitored throughout the greater translocation area. This will include residents that live within translocation sites (hereafter referred to as recipients) and tortoises that live throughout the area but whose movements do not overlap with translocatees or recipients (hereafter referred to as controls). Detailed descriptions of what will be monitored are provided below. Long-term monitoring will involve return surveys to the areas where translocation occurred to assess the status of the translocated population and residents (i.e., recipients and controls) at several time intervals. This assessment may be achieved using one or more of several different measures. For example, one might compare the survivorship of translocated and resident animals that remain at the site, and the demographics and size (age) structure of the translocated population over time relative to control populations. The assessment of long-term success will benefit from genetic analyses to reveal the relative contributions of translocated animals to future generations of tortoises in the recipient population. Detecting these contributions requires some degree of genetic differentiation between the translocated animals and the recipient population in order to differentiate between them initially. This differentiation will likely be at the level of private alleles, rather than broad scale genetic differences. Whatever methods are invoked, the ultimate goal of such monitoring would be to document if the translocation and subsequent management of the translocated population resulted in self-sustaining and healthy populations of desert tortoises. Although this may be an unrealistic goal with current environmental and habitat conditions and subsequently declining tortoise populations. The ultimate measure of success for this translocation plan is the assimilation of the translocated tortoises into the recipient population. Long-term monitoring to assess this goal will include monitoring of the resident and translocated tortoises in the augmented populations and control populations over several time scales (Berry 1986, Dodd and Seigel 1991, Nussear 2004) including months, years and decades. Sufficient funding will be allocated to complete the requisite monitoring over a period of at least two decades.

In addition to those measures of success already discussed, the questions of what role translocation plays in relation to a net loss of habitat and whether or not there is a net gain of desert tortoises such that populations are "bolstered" are relevant questions for which there are no easy answers. The only guaranteed benefit of this translocation is the knowledge gained that can help manage these populations more successfully in the future. Although we expect a high likelihood of success as defined in this document, it is prudent to be prepared for contingencies that have the potential to compromise the status of the translocated, resident, or control desert tortoises. The simplest scenario might be to consider a site where the tortoise population has been locally extirpated of unknown causes. To simply repatriate translocated tortoises to that site without consideration of the original cause of mortality and furthermore to expect the population to flourish seems unreasonable. In this case success would be either for the population to maintain itself, or if it declined to determine the cause of declines such that they could be remedied. Placing translocated tortoise within an existing population creates an even more complicated situation. Since populations are generally declining, the question becomes are they declining in relation to the reduced availability of required and limited resources caused by increased competition, or are they declining due to some other form of disturbance.

II. Translocation Plan – General

Description of Expansion Areas

The NTC will expand into three different areas – Eastgate, the Southern Expansion Area (SEA), and Superior Valley (Figure 1). The expansion is estimated to take place over the course of five years (Table 1, M. Quillman *Personal Communication*). As many as 1500 tortoises are estimated to inhabit the combined expansion areas at Ft. Irwin (Table 1, Fish and Wildlife Service 2004). It should be noted that these estimates are for adult tortoises only and provide no information on the number of sub-adults, juveniles or hatchlings that might inhabit expansion areas. To date, there is no accurate method to estimate the total population size for desert tortoises. Population size estimates for juvenile tortoises are the most difficult to generate because smaller tortoises are difficult to find. For planning purposes we have considered that all activities associated with translocation from the SEA must accommodate 600 adult tortoises and 300 subadult and smaller tortoises. As actual numbers of tortoises are acquired, all estimations should be adjusted accordingly.

Table 1. Expansion areas considered in Phase I of the Ft. Irwin Translocation Plan.

Location	Expansion Date (tentative)	Area (acres)	Estimated # of adult Tortoises (range)
Eastgate	July 2005	48,629	288
SEA	July 2007	24,000	~435 (337 - 640)
Superior Valley	July 2010	70,000	~650 (516 – 1,143)

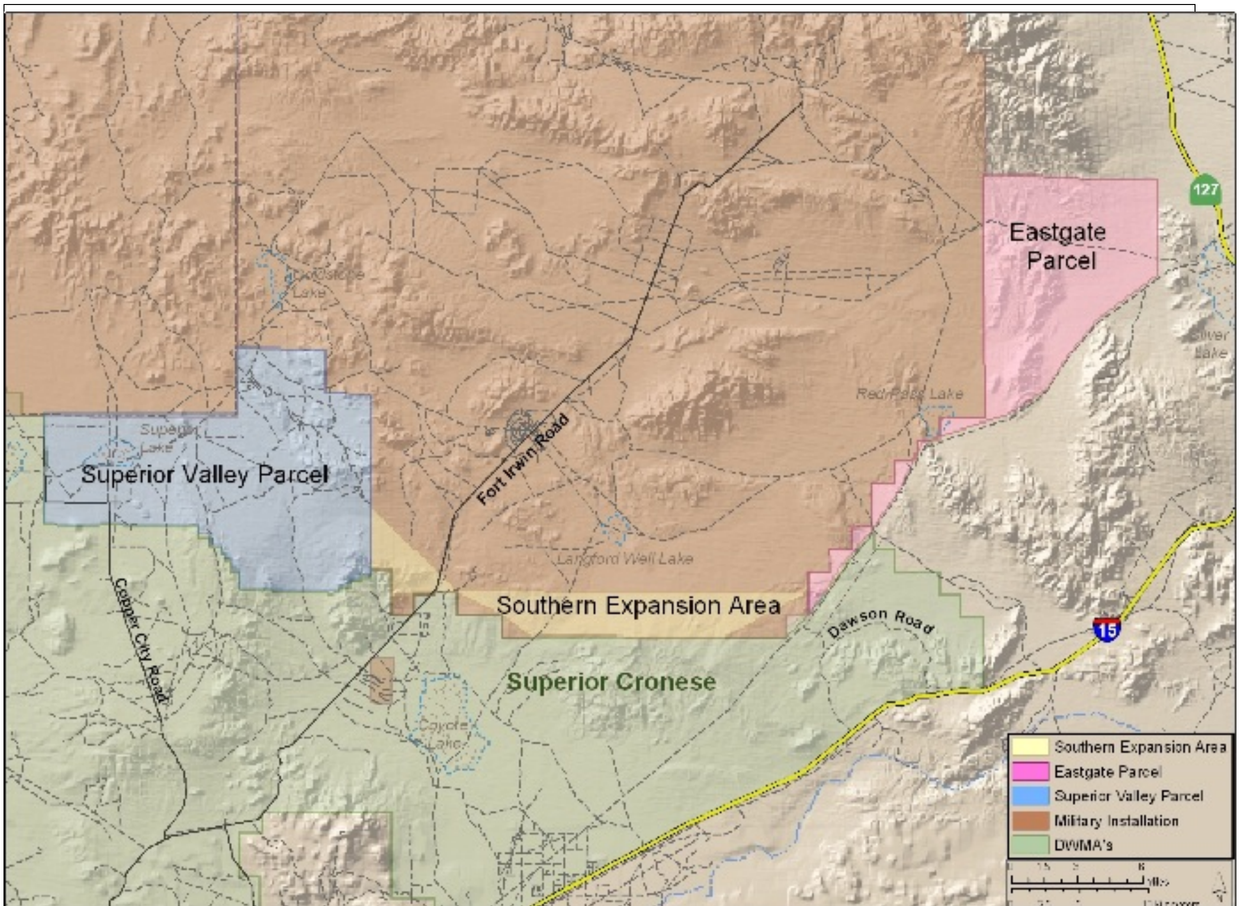

Figure 1. Fort Irwin and the proposed Eastgate, Southern, and Superior Valley expansion areas

Eastgate - Expansion is scheduled to occur in the Eastgate area (Figure 1) by July of 2005. The Fish and Wildlife Service Biological Opinion (2004:4-26) stated “The Eastgate parcel has low to very low tortoise densities” and did not require that tortoises be translocated from this area prior to expansion (Fish and Wildlife Service 2004, pg 46).

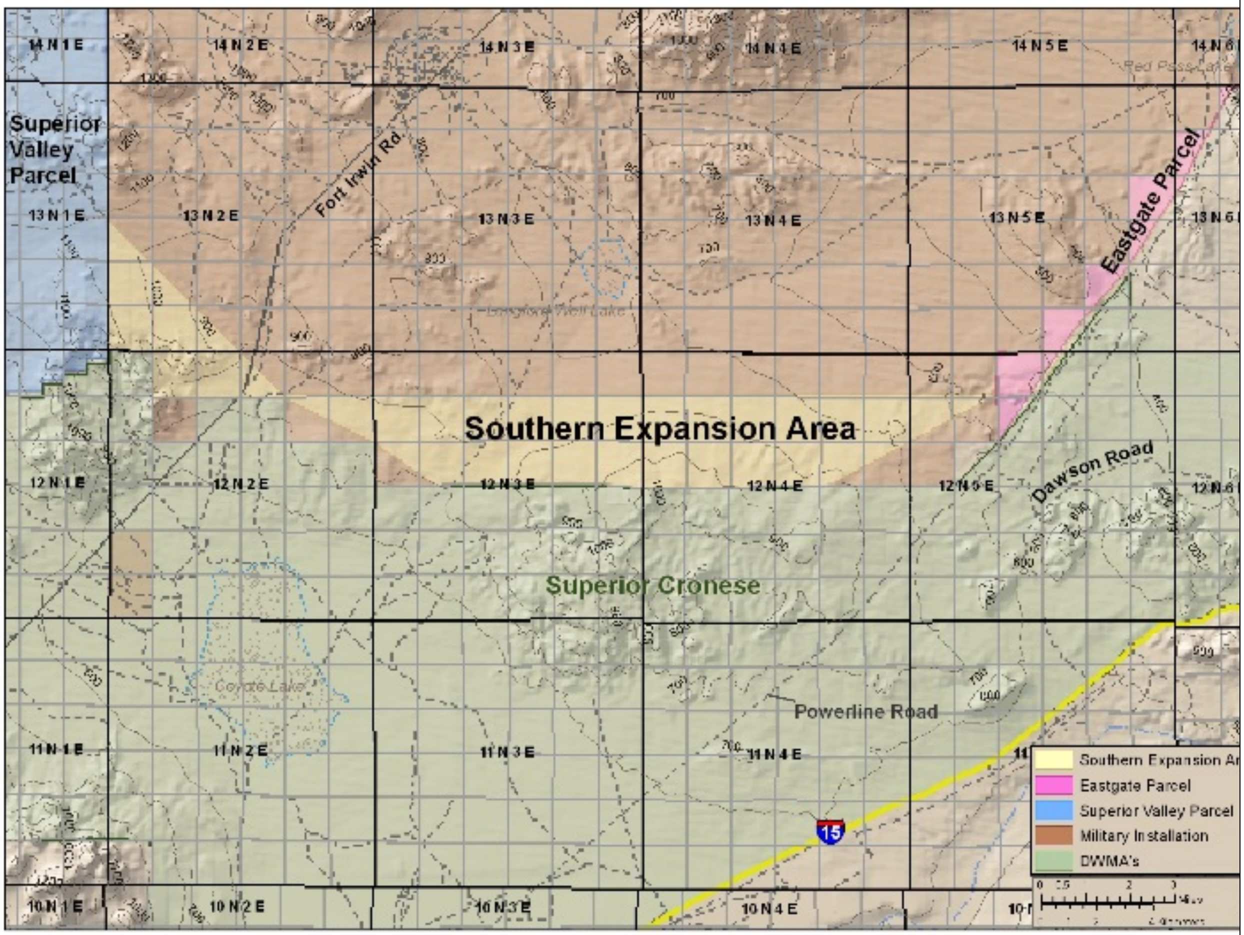

Figure 2. Map of the southern expansion area

Southern Expansion Area

The SEA (Figure 2) comprises a total of 23,214 acres (36.27 sq. mi.) and may contain as many as 640 adult tortoises (Fish and Wildlife Service 2004). Pre-clearance surveys in the SEA will commence in 2005 in the western portion of the expansion area. Military maneuvers are expected to begin in the SEA in late summer of 2007. The Biological Opinion states that desert tortoises inhabiting the SEA will be translocated. Specific locations proposed for translocation from the SEA is provided below (*see* Proposed Translocation Sites).

Superior Valley

Training activities in the Western Expansion (Superior Valley, Figure 1 are expected to begin in 2010 or later. It is estimated that as many as 1,100 adult tortoises require translocation from Superior Valley (Fish and Wildlife Service 2004). This cohort of animals will be the last group that will be affected by the planned expansion. The research findings from the studies on animals translocated from the SEA will be used to provide insight into the best ways to incorporate the Superior Valley animals into future conservation/recovery/ research activities.

Selection of Prospective Translocation Sites

The Recovery Plan (Fish and Wildlife Service 1994) provides several guidelines for the disposition of translocated desert tortoises (Appendix 1). In brief, these guidelines suggest that translocated tortoises should not be placed into DWMAs, they should be placed in good habitat with depleted desert tortoise populations – e.g., along highways (von Seckendorff Hoff and Marlow 2002), and the translocation areas should be fenced. In addition, the Biological Opinion (Fish and Wildlife Service 2004) for the expansion of Ft. Irwin National Training Center (NTC) states that at least some of the displaced tortoises should be placed south of the SEA and on "managed parcels" of land, which places them within a DWMA and in conflict with the guidance provided in the Recovery Plan.

Guidance regarding the selection of translocation sites was also received from resource managers from a variety of agencies on the Conservation Mitigation Working Group. In some cases, differing agency goals confound each other if not considered from a broad perspective. The Biological Opinion required that the translocation plan explain procedures to determine translocation sites (Appendix 2). Ideally, a quantitative habitat model would be used to identify translocation sites. Such a habitat model would rely on multiple interacting parameters at a broad geographic scale that describe desert tortoise habitat in relation to distribution and abundance of tortoises and would need to be validated independently of the data used to develop the model. However, there are currently no widely used models based on quantitative habitat relationships for desert tortoises. For this reason, members of the CMWG decided to take advantage of an existing GIS-based decision support system designed to support tortoise conservation related to the Ft. Irwin expansion. The system was developed by the Redlands Institute, University of Redlands, and funded through the Army Research Office, Department of Defense.

Scientists from the University of Redlands, USGS-Biological Resources Division-Western Ecological Research Center, and the University of Nevada, Reno collaborated to parameterize the GIS decision support system to determine the most suitable sites for translocation. The model was based on geospatial data used in an expert-opinion model of habitat potential, threats to tortoises, recent tortoise surveys, and several anthropogenic factors (i.e., land use, ownership, urban planning) that were considered to be important to the survival of tortoise populations. The expert opinion model is distinguished from a quantitative model, in that, opinions from knowledgeable biologists rather than quantitative information was used to define model parameters. Furthermore, the expert opinion model was not validated. For a detailed explanation of the model and the input parameters please see Appendix 3. The model covered a 7946 sq. mi. core area within the West Mojave Desert Management Planning area (Figure 3). This core area included areas proximate to Fort Irwin, and the DWMAs in the West Mojave, where most of the recent tortoise surveys have been conducted. The unit of analysis for the model was one section of land (~ 1 sq mi). Translocation sites were identified using a spatial decision support system (customized ArcGIS geoprocessing models in combination with Ecosystem Management Decision Support - EMDS). One of the great benefits of this type of system is that it can be used to run hypothetical scenarios that permit investigation of the relative costs and benefits of a variety of potential management actions.

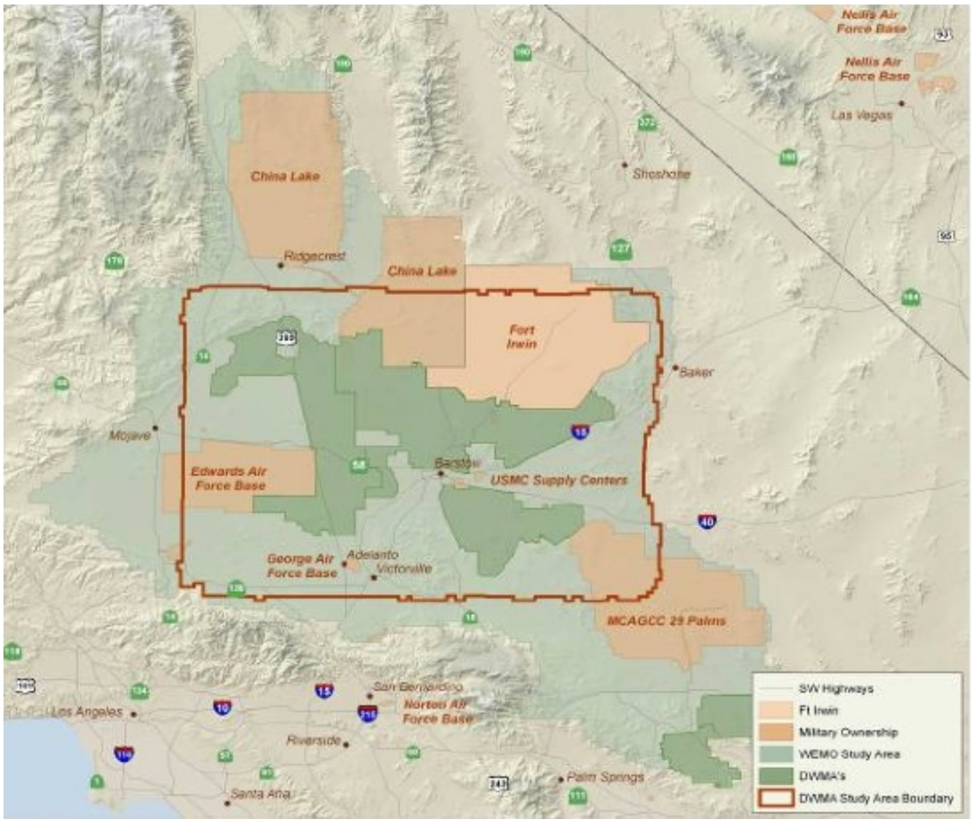

Figure 3. The planning area for this Translocation Plan is represented by the orange rectangular line and is 7946 sq mile in area. This planning area is within the West Mojave Planning area and was used in the GIS model for translocation site selection.

Model Input Parameters

The decision support system used the following input parameters to evaluate sections of land for their relative value as translocation sites in the west Mojave Desert: an expert-opinion model of habitat potential (based on precipitation, soils, geomorphology, elevation, and latitude); critical habitat unit boundaries; proximity to Ft. Irwin (used as a proxy for genetic information); distance from major roads (with scenarios for fencing I-15, Irwin road, Ft. Irwin road, Hwy CA58, and US395); incidence of dirt roads/fragmentation; railroads; land ownership (federal or state vs. private and number of private owners per section); land use designation (e.g., open OHV areas, mining, current grazing status, etc); projected growth (California Division of Finance data); current urbanization; die-off regions: using data from Total Corrected Sign (TCS) and Line Distance Sampling (LDS) transects, and Western Mojave Desert Management Plan (WEMO) data (e.g., road designations, land use planning). The parameters influenced the model in a number of ways (Table 2).

Table 2. The categories into which all model parameters were placed depending on how they functioned in the model.
1. Proximity – caused the assigned value in the model for land parcel rank to increase or decrease as a function of its distance from the following features: • Rank increased with distance from: major roads (unfenced); urban areas; railroads; • Rank decreased with distance from: Ft Irwin (a substitute for Genetics); fenced roads (repatriation of reclaimed habitat)
2. Inclusion – caused the assigned value of a parcel to increase if areas were determined to be die-off regions for desert tortoises (calculated from LDS/TCS transect data and explained subsequently), or where the lands were federally owned or had few (<3) private owners.
3. Exclusion – caused strict exclusion of land parcels if they occurred in areas characterized by the following criteria: an area of projected urban growth (California Department of Finance data) open OHV areas, and areas with unfavorable physical characteristics due to geomorphology (e.g., playas), elevation (e.g., areas exceeding 4250 ft in elevation).
4. Other factors were used to create preference or avoidance of certain areas such as disturbance due to road fragmentation.

TCS data for 1999-2001 and LDS data for 2001-2004 were combined to calculate a "die-off" score for each section in the planning area (Figure 4). This die-off score was a geospatial index of tortoise mortality intended to identify regions where carcasses were predominantly found during transect surveys (Figure 5). All seven years of data from both transect methods were used to identify sections in which only carcasses were found during surveys. A die-off score was then calculated for each section using the formula below (Figure 5). This formula placed a greater importance on sections immediately surrounding the center sections, but was also influenced by sections in the outer ring of sections surrounding the center section. Sections that were not surveyed were accounted for by weighting the influence of each ring by the number surveyed divided by the number that were available to be surveyed. In this way sections near the edges of the study area and irregular sections were not biased by the formula.

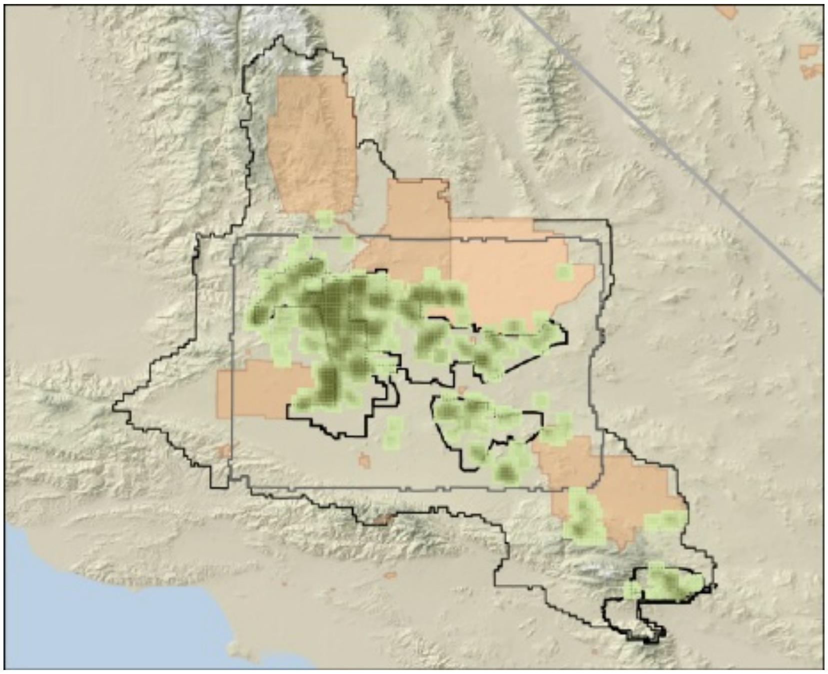

Figure 4. Die-off areas identified by the Decision Support Model. Dark green areas indicate high die-off scores, light green areas indicate low die-off scores, and no green indicates areas where no data were available for analysis.

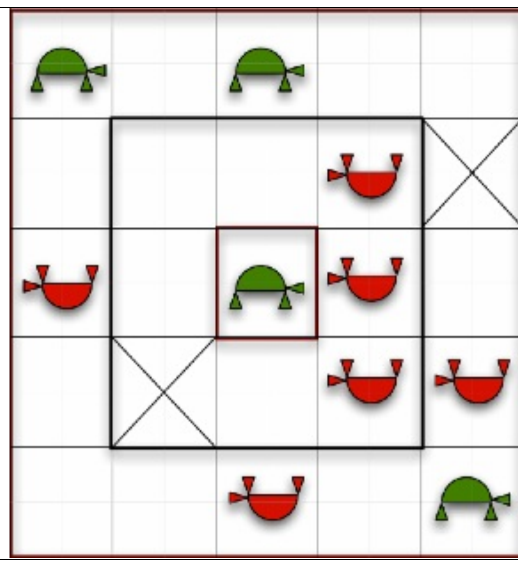

Figure 5. Schematic view of the process for calculating die-off scores for each section. Green tortoises indicate live tortoises, red tortoises represent dead tortoises and empty boxes represent areas where no tortoises were found, and X indicates no survey was conducted to generate data. Die-off Score = [(Self + Number of carcass only sections in the first ring of neighbors) * (The number of sections sampled / Available to be sampled)] + [(Number of carcass only sections in the Second Ring * 0.5) * (The number of sections sampled / Available to be sampled)]. The die-off score for this figure is 4.073=[(0+3)*(8/9)]+[(3x0.5)*(15/16)].

The parameters in the decision support model were arranged in a logical structure, which effectively ranked them according to how important they were considered to be in the decision process. This logical structure was developed by combining the expert opinion of many scientists, managers and stakeholders during workshops hosted by the Redlands Institute Desert Tortoise Project (J. Heaton, University of Nevada, Reno – *Personal Communication*) with guidance from the authors of this plan.

Parameters were assigned to one of two groups according to their importance in the decision process (Figure 6). The most influential group consisted of the following parameters: geomorphology, elevation, land ownership, urban areas, and major roads. This group was weighted such that if any one of the parameters was unsuitable that section was considered unsuitable for translocation (i.e., the logical AND operator – Figure 6). The second group contained parameters that were weighted in proportion to their potential influence on the success or failure of translocation and these values were combined (i.e., the logical UNION operator – Figure 6). For example, this group of parameters considered whether the section was within Critical Habitat Units, an open or closed OHV area, an area considered to be probable for future urban development, whether the area was within a die-off area of resident desert tortoise populations, the level of fragmentation due to open and closed BLM routes, and whether railroad tracks transected the section (Figure 6). The score for each of these parameters was averaged to create a suitability value for the section. This suitability value was then combined with results from the first group to create results expressed as a decision surface for each scenario that was developed with the model. In this way, none of the UNION parameters were allowed to eliminate a land section in and of themselves, but the combined effect of each parameter influenced the overall results.

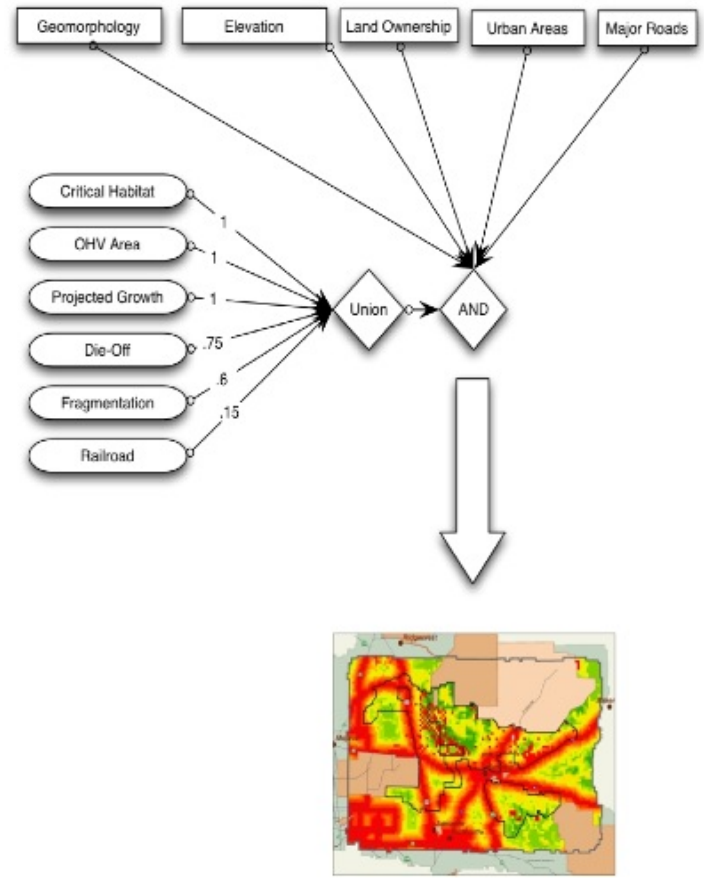

Figure 6. Schematic showing the logical structure of the habitat selection model. Parameters in group 1 are the row of rectangles at the top of the figure. Group 2 are the parameters in the column of ovals. The numbers next to each parameter in group 2 are the assigned weights.

Decision Scenarios

Six permutations of the input parameters were combined to create modeling scenarios that differed from one another in ways thought to be of particular interest for desert tortoise translocation (Table 3). For example, scenario "1" was designed to highlight sections that would be gained by completely fencing all major highways, while still ranking sections higher that were closer to Ft. Irwin. In contrast, scenario "2" was designed to consider the current level of fencing along major highways and not providing a higher rank for proximity to Ft. Irwin. Scenario "3" then combined the factors that were isolated in scenarios "1" and "2" for a final contrast of those important scenarios. To identify the sites that met selection criteria in the most robust way, the results from all six scenarios were then analyzed simultaneously to identify which areas received favorable ratings as translocation sites, and were common among all six scenarios (e.g., Figure 7). From the combined analysis we selected seven areas that contained large contiguous blocks of sections that were ranked favorably as translocation sites for tortoises by the model (Figure 7). The model output for each of the scenarios and the combination of all six scenarios were interpolated to color maps for consideration by the Conservation Mitigation Working Group.

Table 3. Initial scenarios included for prioritizing areas for translocation sites.
1. Fenced major roads (Assumed that I-15, Ft Irwin Road, Irwin Road, and 395 are fenced), areas proximal to Ft. Irwin were favored.
2. Ignore positive weighting of proximity to Ft. Irwin (genetic)
3. Scenario 1 and 2 both applied factors common to scenarios 1 and 2
4. Ignore areas of projected growth
5. Ignore fragmentation due to open and closed BLM routes
6. Ignore preference for inclusion of Critical Habitat Units

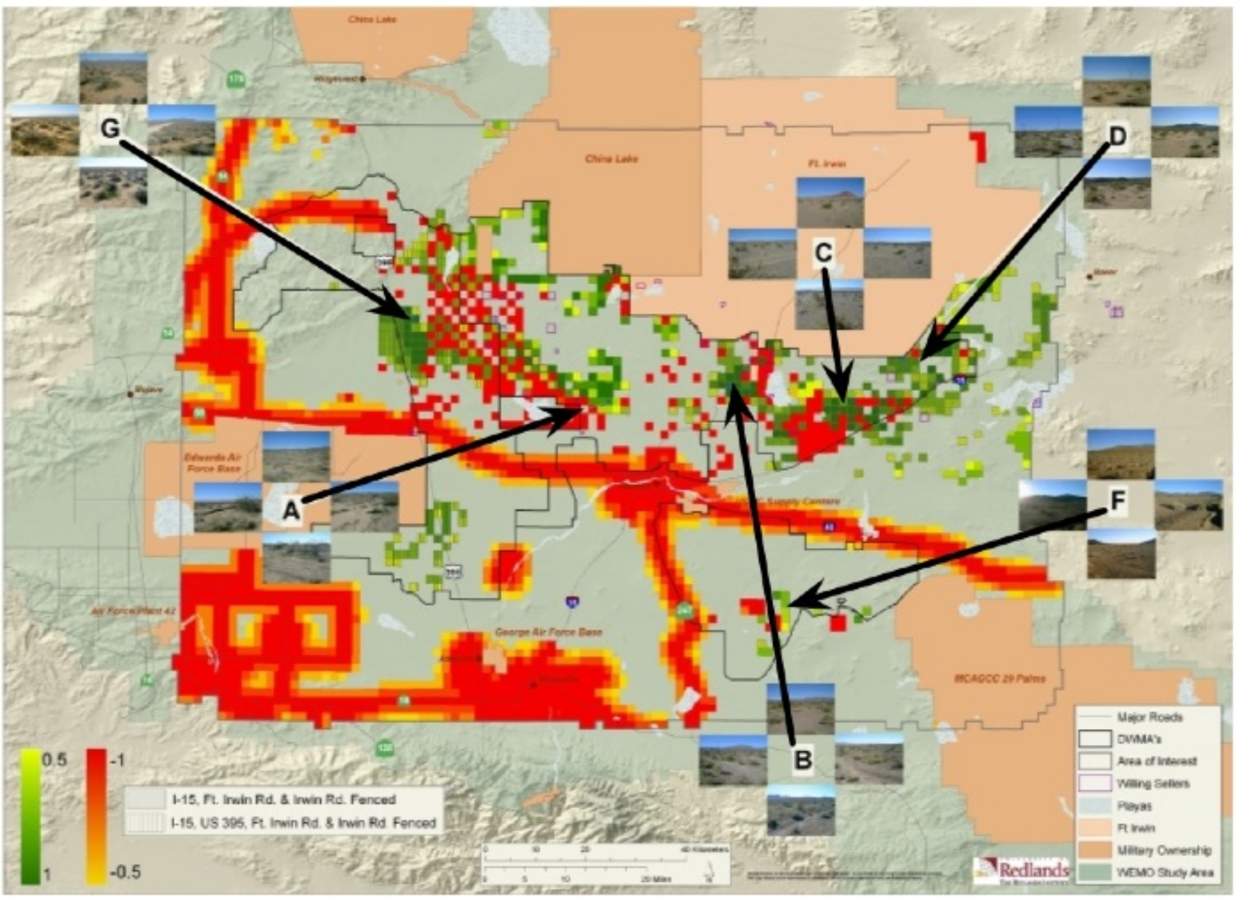

Figure 7. Common good areas among the six scenarios with assumption of major roads fenced. Larger photos of the areas can be seen in Appendix 4

Site Visit to the Common Good Areas

The sites were visited by the authors of this plan (TCE, KEN, PAM) on 2 December 2004. Representative digital photographs were taken at each site for presentation to the translocation committee (Appendix 4). We were able to drive to within 1 mile of the center of each of the common good areas on Bureau of Land Management (BLM) designated open routes. On visitation of the sites, we concluded that some of the sites resulting from model output had atypical vegetation patterns for tortoise habitat (Figure 7 G, F) and others looked like they contained typical tortoise habitat (Figure 7 A, B, D). Sites C, and D were accessible by a major utility corridor. Site D was in proximity to the Ft. Irwin Study Site (FISS – Hazard and Morafka 2002) and consisted of hilly country with outcrops of silt and mudstone and several moderately deep (2-5 m deep) washes. Vegetation at this site was moderate to sparse relative to other *Larrea*/*Ambrosia* dominated sites (i.e. Sites A and B). Site C had more sparse vegetation than any other site. Site B was bisected by Ft. Irwin Road and had the greatest cover of *Larrea*/*Ambrosia* and the shrubs here were tallest of any of the sites. Site A was accessible by a BLM open route that has had heavy use both on and off the road by Off-Highway Vehicle (OHV) traffic. Soils at Site A were coarse sandy/loam. This site was a mixed shrub community with *Yucca brevifolia* as visual co-dominants. Site G was accessed by a graded dirt road and characterized partly as a valley sink with fine soils and vegetation dominated by *Atriplex* spp. and *Grayia spinosa* (many of which were dead). Site F was intermediate between Site G and the other sites with respect to vegetation and soils. Site F also appeared to be in an active grazing allotment as there were cattle present on the site.

The maps and site photographs were presented to the Conservation Mitigation Working Group for consideration as translocation sites on 7 December 2004 (e.g., Figure 7). After thorough consideration of the maps, the Conservation Mitigation Working Group identified additional sites for consideration in addition to those sites identified by the model.

Site Visit by Conservation Mitigation Working Group

Key members of the Conservation Mitigation Working Group returned to the field to visit the sites for further confirmation of the suitability of sites proposed to be used for the translocation of tortoises from the SEA. Six additional sites were visited on December 22, 2004, and a helicopter over-flight of most of the proposed translocation areas was conducted.

The first site was on the north side of some low hills east and north of Dawson Road. The soil was very gravelly and had evidence of lots of sheet type erosion. There was a fair amount of cover from *Larrea tridentata* shrubs with some *Ambrosia dumosa, Encelia farinosa,* and *Hymenoclea salsola*. This site would possibly make a good location for the release of translocated tortoises.

The second site visited was south of the Kern River pipeline and the power line corridor and about 2 km west of Dawson Road. The habitat looked good, there were a fair number of moderate sized *Larrea* shrubs present. East of the landing site we observed the remains of an adult female desert tortoise (no marks of scavenging present). This location possessed a fair amount of relief with bajadas about 10 m high and lots of open-faced banks that would afford desert tortoises ample locations to construct burrows. The first and second sites were near site D described above.

The third site was at the Southeast end of Alvord Mountain north of the numerous power lines, and just north of site C described above. This site consisted of much open habitat without much cover. There were widely spaced *Larrea* shrubs and not much else in the way of cover. Mounding was present around *Larrea* shrubs from rodent activity and numerous caches of seeds were seen germinating. To the north of the landing site we observed a number of incised canyons with arroyos draining the mountainous habitat. These canyons are likely to be excellent tortoise habitat but are probably not able to support large numbers of tortoises as would be required for translocation sites.

Between Site three and Site four we flew around the north slope of Alvord Mt. The area between the UTM 87 line and the northern slope of the mountains appears to be an excellent location to consider placement of tortoises not retrieved during the clearances of the expansion areas. (i.e., tortoises found after major translocation efforts are completed).

Site four was on the west side of Alvord Mountain on the juncture of the bajada and the foothills, and east of the Coyote Dry Lake. The slope leading to Coyote Lake has numerous washes and a fair amount of *Larrea* with *Cassia linata* present in many places. This site looks like good habitat, the downside is the presence of numerous private land parcels to the south and west that preclude acquisition.

Site five was southwest of Coyote Lake on the north slope of Calico Mountains. This site looks very good, there were numerous fair sized *Larrea* shrubs ~1.5 m tall, lots of rodent activity and excellent germination of annual plants. The soil looks friable and excellent for maintaining tortoise burrows. The foothills on the north slope of the Calico Mountains possess a fair number of canyons and this may serve as a good translocation site. The only drawback might be the proximity of private land parcels to the north as you approach Coyote Lake.

The sixth site was approximately 3 km West of Ft. Irwin Rd. in the foothills of the south side of Superior Valley. Inspection of this highly dissected habitat of low hills and *Larrea*/*Ambrosia* habitat indicates that it would be an excellent location for desert tortoises. There was a large wash/road traversing the Superior Valley north/south to the north of the site. The valley bottom possesses large widely spaced *Larrea* shrubs with not much cover between them. Likewise, numerous annual plants have germinated and it will provide much food for tortoises this spring. Sites four and five were in the valley surrounding site B described above.

Proposed Translocation Sites

From among the six areas identified in the common model that assumed major roads were fenced, three general areas seemed most appropriate for the translocation of tortoises from the SEA. The sites that were ranked most relevant for the translocation of the tortoises from the SEA fall within the polygon indicated by the blue-dashed line in Figure 8. These were sites B, C, and D (Figure 7, above with fenced scenario). This conclusion was further supported by the visit conducted on December 22, 2004 by members of the Conservation Mitigation Working Group. The appropriateness of these sites is highly influenced by whether or not the north margin of the Interstate-15 highway corridor is fenced. If this corridor is not fenced, it is likely to have a negative influence on tortoises that are released in nearby sections. If this area is not fenced, then a new scenario should be created and run through the model to evaluate more accurate fencing information (e.g., Figure 9).

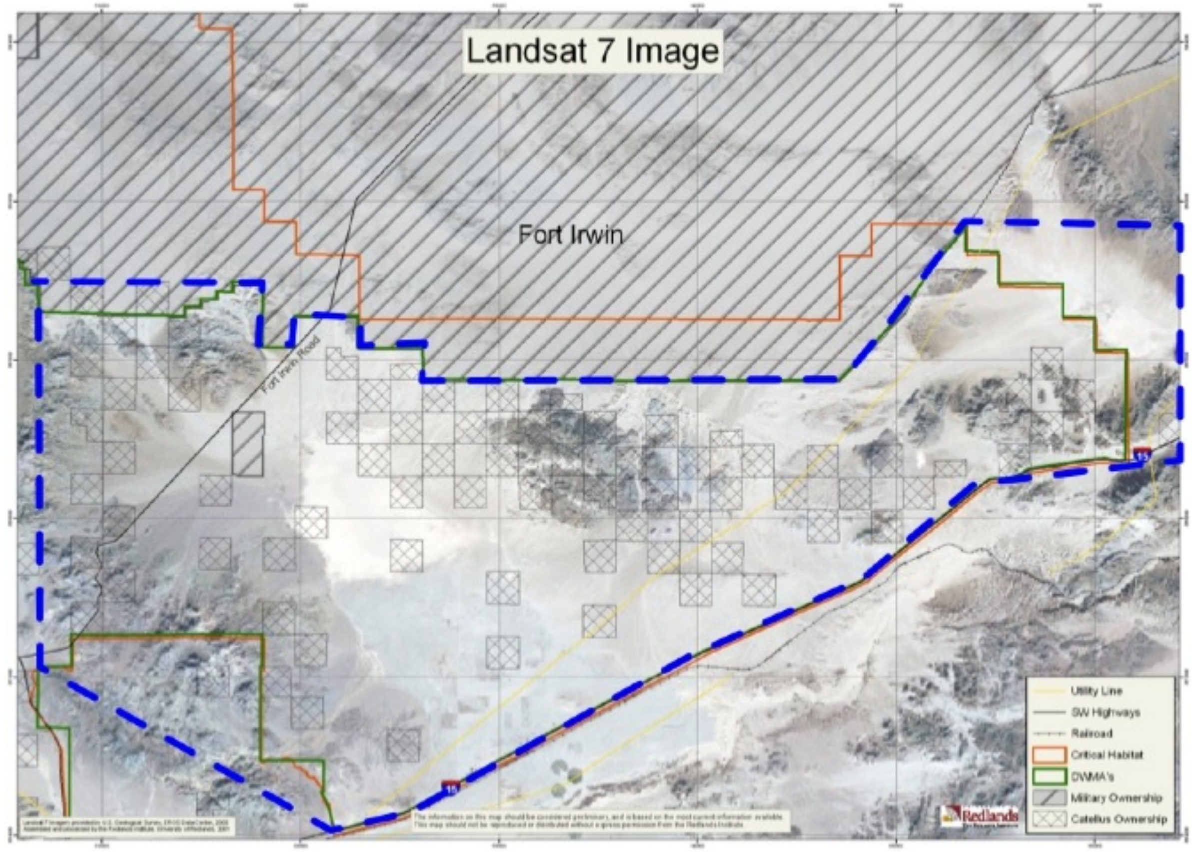

Figure 8. Map of the greater translocation area that will be affected by the translocation of tortoises from the SEA. The green polygon indicates the Superior Cronese DWMA boundary, and the blue polygon indicates the complete footprint of all translocation activities.

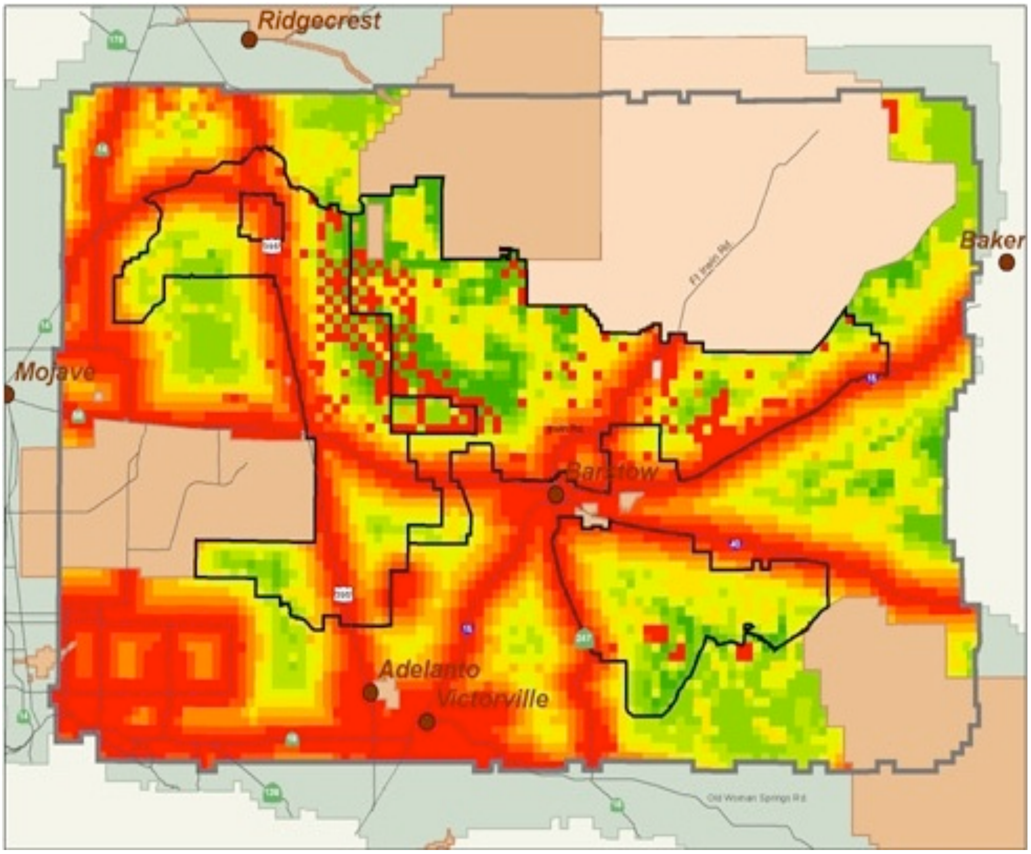

Figure 9. Common scenarios where the major roads are not fenced.

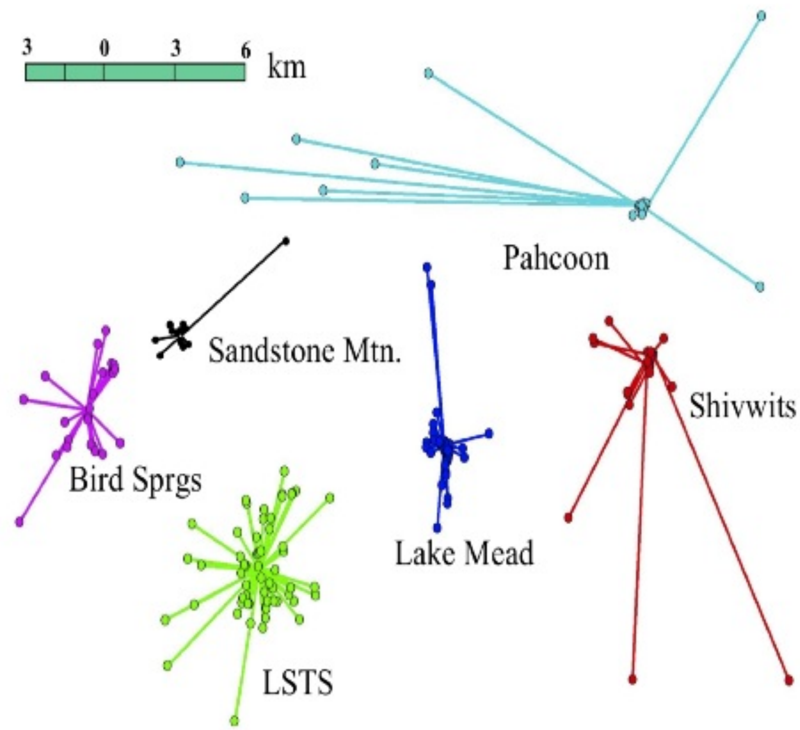

Figure 10. First year displacement distances of tortoises translocated to sites in typical habitat in Nevada (Bird Springs, LSTS, Lake Mead) and Utah (Sandstone MTN), and of tortoises translocated to atypical habitat (Pahcoon, Shivwits).

Translocated tortoises have been reported to move long distances immediately after release while in search of home ranges, or new territories (Berry 1986, Field 1999, Nussear 2004) (Figure 10). The ability of tortoises to move large distances creates a dangerous situation if major roads are not fenced. If tortoises are to be released within 10 km of a major road it will be fenced prior to translocation. This may be especially relevant in atypical or unfavorable habitat. We estimate that approximately 13.6 miles of the northern side of Interstate 15 would need to be fenced, in addition to the fencing already planned for Ft. Irwin Road, and the UTM 87 line. Fort Irwin will work with CalTrans in erecting desert tortoise-proof fencing along Interstate 15 from Afton Canyon exit to the vicinity of Yermo by providing funding, manpower, or both.

III. Clearance Procedures for the SEA

Timing of Clearances

Prior to translocation of any tortoises each expansion area will be completely surveyed for desert tortoises. Tortoises located during surveys must be removed from the SEA by the spring of 2007 if military activities are to commence by July 2007 (Table 1). This requires enumeration of tortoises in the SEA, and complete preparation of translocation sites (specific site selection, screening the health of individual tortoises, planning for fencing where required, contracting for fencing, etc.). Enumeration of tortoises in the SEA will be completed by fall of 2006. Survey of translocation sites and studies of resident tortoises will also be initiated as soon as possible (i.e., spring of 2005) so that baseline data on habitats and resident tortoises can be acquired prior to translocations as recommended by Guideline 7 of the Recovery Plan (Fish and Wildlife Service 1994). Permits authorizing all activities related to tortoise capture and handling will be acquired from appropriate agencies (i.e., Fish and Wildlife Service, California Department of Fish and Game, and Bureau of Land Management). All work identified below is subject to Terms and Conditions of state and federal permits and may be altered or modified to meet these conditions.

Research and Development of Clearance Methods

Recent research on surveys for tortoises opens the possibility to use canine-assisted search teams to increase efficiency and accuracy of searches compared to human search teams (Bjurlin 2004, Cablk and Heaton 2004). This method could result in a more complete removal of tortoises in the expansion areas. Scientists from the University of Nevada, Reno, the Desert Research Institute, and the USGS will conduct an experiment in 2005 to compare the costs and benefits of using human search teams for desert tortoise surveys compared to canine-assisted search teams. Briefly, the experiment is designed to determine if canine or human teams locate desert tortoises of all size classes more efficiently and with equal safety for the tortoises involved. An area of approximately 10 square miles has been selected for experimental surveys. One-half of the sections will be surveyed first by canine-assisted teams, and the other half will initially be surveyed by human teams. Then the teams will switch locations and search the areas previously searched by the other team. At the conclusion of the searches researchers will provide an analysis of the results and recommendations to the U. S. Army and the Conservation Mitigation Working Group for conducting additional clearance surveys on the remaining 26 square miles in the SEA that contain desert tortoise and that were not part of the human/canine-assisted search team experiment.

SEA Clearance Teams

After the most effective search method is identified the remaining area of approximately 26 square miles of the SEA will continue to be searched using the most efficient method. The remainder of the expansion area will be searched using two complete passes by tortoise survey teams as recommended by the Fish and Wildlife Service (R. Bransfield *Personal Communication*). All clearance activities will occur when ambient temperatures are below 35°C and in accordance with permitting requirements for handling desert tortoises. Clearances should be conducted using 3 teams including: a search team, a telemeter/data team, and a field coordination team. This is because search teams must maintain an adequate pace in order to complete daily coverages on schedule. Every tortoise that is found will require a significant amount of processing time to attach radio transmitters and perform necessary measurements. This would best be handled by specialists whom we refer to as the telemeter/data team. There may be multiple search teams and during first passes across sections there should be a telemeter team assigned for each search team. The field coordination team should be used to determine work force, maintain communications, provide oversight for the safety of tortoises and field teams, and collect data at the conclusion of each day.

Tortoise Procedures

Upon locating each tortoise during surveys the following information will be recorded and archived: time tortoise is located, time telemeter team arrives, the location of each animal will be determined using a GPS, tortoises will be marked appropriately according to size, measured (Carapace Length in mm), weighed, general notes on appearance and health will be recorded (i.e., eyes, nares, shell condition, etc.) and then, they will be released, as soon as possible at the point of capture. Time of release will also be recorded. All of these data will be included in a final report of activities.

Tortoises found during clearances may be: 1) marked with Passive Integrated Transducer (PIT) tags (Gibbons and Andrews 2004) (e.g., Biomark model TX1400L); 2) fitted with an external label and notched (ASIH 2004), and 3) have a light-weight radio transmitter attached with a battery life of at least one year (e.g., Holohil model AI-2F). Approved sterilization and handling techniques will be used as required by the Terms and Conditions of State and Federal permits (Desert Tortoise Council 1994, revised 1999). This redundant method of marking tortoises ensures that tortoises are easily identified by field workers, even in the case of predation or shell wear. Transmitters should be attached using methods similar to those described in Boarman et al. (1998). Dataloggers may be attached to tortoises to record micro-climate and body temperatures (Nussear et al. 2002). All transmittered tortoises will be monitored at least monthly until they are translocated to a release site. By fitting transmitters to tortoises and leaving them *in situ*, we obviate the need to hold tortoises between the period when they are initially captured, and the time when they are subsequently transferred to the translocation area. This procedure will help to minimize stress prior to translocation

Health screening and disposition of ELISA positive tortoises

The presence of Upper Respiratory Tract Disease (hereafter referred to as URTD) has been hypothesized as always having been present in wild desert tortoise populations and is exacerbated by stress (M. Brown – *Personal Communication* to Tracy et al. 2004). Stress can be imposed by a number of factors, such as drought, habitat degradation, poor nutrition, and the densities of tortoise populations (Jacobson et al. 1991, Peterson 1994, Saethre et al. 2003).

The emergency listing of the desert tortoise as endangered in 1989, and its subsequent listing as threatened in 1990 (Fish and Wildlife Service 1989, 1990) was in part due to the documentation of URTD in wild tortoise populations. This disease may have been, in part, responsible for the significant declines observed in the Western Mojave Recovery Unit in association with other stressful factors and impacts to tortoise populations.

Additional diseases have subsequently been documented in wild tortoise populations, including shell disease (cutaneous dyskeratosis) (Christopher et al. 2003), herpes virus (Origgi et al. 2002), *Mycoplasma testudinium* and proliferative pneumonia (Jacobson and Berry 2004). The prevalence of these two conditions has been documented in a few specific locations within the Mojave Desert. Although seroepidemiological research has been conducted (Brown et al. 1999), epidemiology and the impacts of these organisms on tortoise populations have not been assessed widely (Tracy et al. 2004).

The Biological Opinion on the Fort Irwin expansion (Fish and Wildlife Service 2004: 41) stated that the translocation plan should address issues related to the detection and transmission of disease. All tortoises (i.e., monitored recipient, control and translocated) will have examinations for the purposes of disease screening and genetic sampling before they are taken from their original habitat. This examination may include an assessment of the overall condition of the animal and its shell, looking for visible signs of herpes lesions, URTD symptoms, trauma, and cutaneous dyskeratosis (Berry and Christopher 2001). In addition, blood samples will be collected for laboratory examination of disease, assessment of genetics, and possibly to determine baseline stress levels (Henen et al. *In Press)*. Blood samples will be collected later in the activity season in order to ensure that the immune system is active (e.g., May through October). Blood can be drawn from a variety of locations, including ventral coccygeal, brachial, jugular, cardiac, subcarapacial venipuncture, supraorbital sinus, and toenail clipping (Jacobson 2000, ASIH 2004). The exact location used for bleeding should be determined by the volume of blood needed to complete all analyses desired at that time. Tortoises that are moribund and too sick to be used in field studies may be necropsied for pathological study.

Tortoises that are ELISA positive for the antibodies to *Mycoplasma* and tortoises that show signs of URTD, will be isolated when translocation occurs. These tortoises will be placed in isolated sites either outside the DWMA boundary, or on property already owned by the Department of the Army just inside of the DWMA boundary, or within the boundaries of the military installation. The quarantined desert tortoises will be confined within double-fenced pens to ensure that they do not come into physical contact with resident tortoises in the area. It is estimated that approximately 6 miles of fencing would be required to build a double fence that covers ¾ of a square mile. These tortoises may be used during future research activities or participate in headstart programs as appropriate. Rostal et al. (2001) studied a group of captive tortoises that were diagnosed as ELISA positive in 1991 and have been maintained successfully for over 10 years at the Desert Tortoise Conservation Center in Las Vegas, Nevada. Those tortoises are watered and provided with supplemental food. These animals reproduce normally producing the same number of eggs and clutch sizes as control animals. This suggests that captive ELISA positive animals may contribute to recovery of depleted tortoise populations.

Resident tortoises in the translocation area are currently (as of May -September 2005) being evaluated for baseline clinical health and disease by Kristin H. Berry and others. Each assessment includes examination for clinical signs of health and disease; photographs or images of carapace, plastron, nares, and eyes, including additional images of any abnormalities, recent trauma, or old trauma, or signs of shell disease; blood samples from the brachial vein of each tortoise sufficient for multiple tests, e.g., 2 ELISA tests for *Mycoplasma agassizii* and *M. testudinium*, potential herpes virus tests, PCRs; sufficient blood for future tests; and nasal lavage for cultures of *Mycoplasma* species and other organisms.

Clearance of Subadult and Smaller Tortoises

Size is currently a limiting factor to monitoring desert tortoises. Some tortoises are too small to carry a transmitter (i.e., tortoises <300g, or 150 mm (Medica et al. 1975)) that will last 1 year and will be marked and removed from the field, tested for disease and moved to temporary storage enclosures (i.e., mini-FISS enclosures (Williams 2002), or the FISS neonatal tortoise enclosures that are already established at Ft. Irwin (Hazard and Morafka 2002) as they are encountered. The mini-FISS enclosures consist of temporary structures (i.e., lacking a foundation) supported by metal poles (2-3 m tall) and completely covered by mesh to exclude all types of vertebrate predators including common ravens. The temporary structures enclose native vegetation and are erected in such a way as to minimize surface disturbances. While in the FISS enclosures the tortoises and the enclosures will be checked according to the “ELISA and Juvenile Tortoise Plan” (Appendix 5). Juvenile tortoises will temporarily be held at the enclosures until they are moved to the translocation area or are used to benefit ongoing research on neonatal tortoise ecology, head-starting, etc.

V. Translocation Procedures

Prior to translocation of animals the selection of recipient sites and inter-agency agreements will be finalized. In addition the Army will coordinate with any ongoing research in the area. The fencing of major roads and any tortoise containment fencing will be identified so that construction of those fences can be planned, contracted, implemented and completed in time for the sites to receive tortoises from the expansion areas prior to training activities (see Time Line of Activities).

Disposition of Desert Tortoises From the SEA

Those tortoises found to be ELISA negative will be moved to one of two general types of translocation sites including: 1) long-term translocation sites, and 2) manipulative experimental translocation sites. Due to the multiple use mandates on BLM lands it is unlikely that fenced plots used for manipulative experiments can be located on BLM lands within the timeline necessary for translocation. Therefore, it is likely that these plots would be constructed on lands acquired by DOD that are within the translocation areas. It has also been proposed to place some proportion of translocated animals into areas where die-offs have previously occurred (Fish and Wildlife Service 2004). Tortoises in the Superior Valley expansion area may be more conducive to this research as there is more evidence of large die-offs adjacent to that expansion area (Figure 4, Tracy et al. 2004). The proportions of tortoises to be placed in areas where die-offs have or have not previously occurred will be determined by the Conservation Mitigation Working Group and the requirements for experiments in the translocation sites.

Translocation Densities

It is unlikely that the sites that meet other translocation criteria will have empirically known "pre-decline" densities. We have considered historic densities, results from recent experiments and guidance in the Recovery Plan to aid in determining target densities for proposed tortoise translocation sites. Research on the effects of density on desert tortoise ecology has been conducted by the USGS and UNR in several semi-natural tortoise enclosures. Possible density effects on growth were observed at densities greater than 500-800 tortoises per sq. km [1295-2072/sq mi] (Saethre et al. 2003). Adult tortoises will be translocated in small groups (e.g., 50-70 /sq. mi [19–27 / sq km]) to many different sites in order to disperse them throughout the release areas. Recent density surveys for the Superior-Cronese DWMA estimate approximately 7.5 tortoises per sq km [19/ sq mi] (P. Medica, *Personal Communication*). Thus, given these densities, the number of adult tortoises is not expected to exceed densities of 100 per square mile [39/sq km] after translocation. The majority of these animals may not need transmitters, but could be monitored using less intensive sampling methods. If conducted correctly a subset of these animals could be monitored more closely (in combination with resident tortoises of comparable numbers). The remaining tortoises could be translocated into several fenced plots for more closely controlled experimental manipulations. The proportions of animals assigned to each of these types of translocation sites should allow for sufficient replication and controls required by any experimental design. To distribute 600 animals at release densities of 50-70 tortoises per square mile approximately 9 to 12 sections of land will need to be designated as translocation sites. In addition, an appropriate number of local control animals will be monitored in similar habitat throughout the translocation area.

Protection of Translocation Sites

Each site will likely have its own protection and management needs. Major roads near release areas will be fenced in order to prevent tortoises from crossing, or being killed on these roads. The entire translocation area will not be fenced due to the prohibitive logistics and costs associated with constructing fencing. Alternatively we suggest that fencing be placed strategically and that physiography also be used as barriers to tortoise movements where possible. For example, during previous translocations in Nevada, mountainous areas that provided a precipitous change in elevation in excess of 2500' functioned as barriers to the movements of translocated tortoises (Nussear 2004). A portion of the tortoises will be monitored as they disperse and settle into the recipient habitat. If a particular desert tortoise that has a transmitter approaches a dangerous feature, such as a portion of a major road that has not been fenced, it will be moved to a location more central to the translocation area. Similarly, if a translocated desert tortoise is found on privately-owned property, it too may be moved to another area to ensure its safety.

As mentioned above some tortoises may be released into smaller experimental release pens. These pens will be monitored by researchers frequently to ensure that the animals are not falling prey to unnatural levels of mortality due to the experimental manipulations, and that the pens are not damaged by flooding or vandalism. The wire mesh used to build tortoise-proof fences is fine enough to capture debris carried during surface flow of precipitation, even during mild storms. Eventually this debris accumulates on such fences and if not removed potentially can cause a breach in the fence thus putting animals and experiments at risk. During previous desert tortoise experiments, using similar pens, storms in excess of 2.5 cm falling in less than 2 hours produced enough runoff to damage perimeter fences and place experiments at risk (T. Esque, *Personal Observation*). For these reasons a perimeter check of experimental fences and highway fences will be conducted quarterly. Precipitation events that result in intense storms will result in immediate perimeter checks and appropriate maintenance.

In the long-term, if all of the proposed translocation sites are located within Desert Wildlife Management Areas (DWMAs), their long-term protection should be assured by the land management agency with jurisdiction over the lands contained in and surrounding the translocation sites by management plans that are already in place. If tortoises are translocated to public lands that are not within DWMAs they will require additional management considerations if their long-term protection is to be ensured.

Translocation Procedures

Translocations will only occur in the spring (i.e., March – early May), fall (i.e., late September to early November), or winter if necessary (i.e., December –February) to avoid extremely high thermal conditions (Cook et al. 1978, Nussear 2004). Tortoises will not be released in the summer (i.e., June - August) for any reason. No desert tortoise shall be captured, moved, transported, released, or purposefully caused to leave its burrow for whatever reason when the ambient air temperature is above 95 degrees Fahrenheit (35 degrees Celsius). No desert tortoise shall be captured if the ambient air temperature is anticipated to exceed 95 degrees Fahrenheit before handling or processing can be completed. Tortoises will probably be found in burrows when field crews are removing tortoises from expansion areas. These animals will be "tapped" to encourage them to exit (Medica et al. 1986) or they may require careful excavation (Desert Tortoise Council 1994). Multiple visits will be necessary if tortoises are inaccessible in caves. Tortoises with radios that were attached during clearances will be collected from field sites and transported in vehicles or helicopters to the translocation sites by biologists that have been approved by the Fish and Wildlife Service to handle desert tortoises, and released on the same day. Juvenile tortoises (those too small for radio attachment) which were housed elsewhere after clearance will be translocated at this time as well. During translocation, tortoises will be transported in clean protective containers to ensure their safety during translocation. If re-used, these containers will be sterilized using a 10% bleach solution before being used to translocate other tortoises.

Upon release, all tortoises will be provided drinking water for 15 to 20 minutes, and then be released into an unoccupied tortoise burrow (if available) or in the shade of a shrub. Previously, desert tortoises released into artificially made burrows showed no fidelity to those sites, often leaving them immediately (Field 1999, Nussear 2004). Suitability of release depends on the severity of the daily ambient temperature at the time of release (Lohoefener and Lohmeier 1986, Corn 1991, Field 1999, Nussear 2004). Tortoises released in winter will be placed in a burrow that is covered by a masonite board to encourage the tortoise to remain in hibernation (Nussear 2004). Previous experience with this technique indicates that to procedure does not confine the tortoises against their will. If they want to leave the site, they can. The masonite board will be removed by early March when resident tortoises are observed to be active.

In recent studies on translocation, animals were observed after release under similar conditions to those proposed herein, and all those animals were able to find suitable shade resources without showing signs of overheating or thermal duress (Field 1999, Nussear 2004). The released animals rarely returned to the burrows in which they were released but found or constructed other suitable cover sites nearby.

Tortoises that are equipped with transmitters and released into unfenced areas may be tracked at least once, or preferably twice weekly until the onset of hibernation (Nussear et al. *In Review*). This is because these animals are likely to disperse from the site of their initial release and may range widely (Field 1999, Nussear 2004). The typical range of radio transmitters for tortoises (~700 - 900 m) makes them particularly difficult to track during periods of large movements which can be greater than the range of the transmitter in a single day (Esque 1994, K. Nussear *Unpublished Data*).

Determining when desert tortoises would be moved across the southern boundary fence

Tortoises that are not found during the clearances of the expansion areas may be encountered at a later date during military training activities. If possible, these animals may be incorporated into one of the translocation/research programs. If there is no way for them to be incorporated into one of the research programs, they will be moved to a pre-determined location across the southern boundary of the training area, such as between the Alvord Mountains and the UTM 87 line, as suggested in the Biological Opinion (Fish and Wildlife Service 2004). However, animals that are placed over the fence (a relatively short distance) should be held in captivity until environmental conditions are hospitable for the release of tortoises and consistent with the conditions described for translocation.

VI. Monitoring for Short and Long Term Success and the Assessment of Threats

A properly designed monitoring program includes short and long-term metrics and hypotheses that are used to provide information that can be used to critically evaluate if management goals are met and provide guidance for adaptive management for future actions (Morrison 2002). Due to financial limitations, it is unlikely that every metric identified below can be measured. Prior to translocation, the scope of the research program for monitoring the short- and long-term success of this translocation will be finalized by the Conservation Mitigation Working Group. The research program will be structured (Latta 2000, Salafsky et al. 2002) to ensure that there is coordination among all of the research activities conducted under this translocation plan. To facilitate plan administration, the Conservation Mitigation Working Group or a similar body will meet on an annual basis to review progress and share information. These meetings are to be focused on the annual activities and progress over the year, and to assess whether the research activities are within the thresholds bounded for the goals for each of the criteria for success. In addition this review committee will facilitate coordination and data dissemination among all field researchers. A framework will be developed to collect and archive all field data so that the assessments of the long-term goals are accurate and to assure that the data from all activities conducted under this plan are archived.

Criteria for evaluating the success of this translocation plan must be based on parameters that are quantifiable and hypothesis driven (Tracy et al. 2004). The parameters that are described in the following section were selected to measure responses of tortoises to the range of environmental variation they encounter such that success of the translocation project can be evaluated. While each of the variables have different responses we generally expect that translocated tortoises should have similar responses as that of control animals after they have had up to five years to adjust to their new environments in order for translocation to be judged "successful" in the short-term.

The ultimate measure of success for this translocation plan is the assimilation of the translocated tortoises into the recipient population. Growth, reproduction and physiological parameters are an integration of nutrition, behavior and social interactions. Long-term monitoring of at least one generation of tortoises will be required to determine if the translocation is successful. We define a generation as the time required from hatching to first reproduction. Desert tortoises are generally sexually mature when they reach over 180 mm carapace length (Turner et al. 1986, 1987b). The time it takes for desert tortoises to reach this size ranges between 15 to 20 years depending on resource availability and environmental conditions during their development (Turner et al. 1987b, Tracy and Tracy 1995).

Many metrics can be used to measure the success of translocation in both the short- and long -term. This translocation project involves a sufficiently large number of tortoises that will make it possible to test hypotheses rigorously, which will increase our knowledge of how to conserve this species into the future. Importantly, each parameter that is measured will be compared between translocated, recipient and control populations. Short-term ecological metrics will provide information about the ways translocated tortoises are adjusting to their new locations and whether or not the introduction of translocated tortoises into a population has a negative or positive effect on resident tortoises. Short-term ecological metrics may include: growth rates (more relevant for smaller size classes); movements; site fidelity; survival rates; stress; incidence of disease; nesting success; reproduction; recruitment; nutritional ecology; and behavior and social interactions. Long-term metrics of success will be measured at several time scales over one tortoise generation. These metrics may include: survivorship (proportions of residents vs. translocated animals surviving); population status (e.g., population densities over time); demographics; genetics (e.g., paternity and maternity); and disease (to understand the long-term ramifications of disease at artificially increased population densities). Research on many of the metrics that we will use to assess short-and long-term success of translocation will address nearly all of the recommended research specified in the Recovery Plan (Fish and Wildlife Service 1994, p54).

It is important to acknowledge that threshold values used to measure success of the translocation activities may initially be somewhat unrealistic but our ability to identify more realistic values will improve as new data and techniques are acquired and developed. To the extent possible, the thresholds suggested herein were developed using data from previous translocation studies although these may still be value judgments and we will not know the ultimate result of our management actions until long term criteria are analyzed. However such values are useful as milestones against which to compare differences between translocated and control populations in relation to one another, and to local environmental change. Differences in short or long-term metrics between translocated and control populations that exceed threshold values may be a reason to alter management actions or even to discontinue specific activities in the most severe cases. Ultimately the translocation must be measured in consideration of the costs and benefits of moving the tortoises and their effect on recipient populations compared to the potential loss of the translocated populations had they remained in the expansion areas.

All response variables that are used to evaluate the level of success for this translocation plan must be considered relative to the responses among the three experimental groups of tortoises (treatment groups).

We can not simply interpret the responses of the different treatment groups independently from one another, but rather comparisons must be made relative to one another. This avoids the problem of interpreting responses (e.g. mortality) as a result of translocation, when they may in fact be caused by uncontrollable conditions (such as extended periods of drought). Most response thresholds are proposed herein to be a differential of 20%. Note - this is not an absolute response level, but rather a differential response level to be compared among the treatment groups of animals. Furthermore, this value is provided as initial guidance, and as such is subject to change as new insights or data become available. The 20% difference is thought to be biologically meaningful (i.e., a difference of this magnitude between translocatees and controls reflects something that will likely affect the persistence of a cohort of animals and therefore the success of the translocation effort) and 20% is also a difference that is likely to be detectable given the sample sizes that will be available. For example, suppose there are 12 release sites where translocated and recipient tortoises are monitored, and control tortoises are monitored in surrounding control areas. We record (in a hypothetical year) mortality levels of 22% (± 4 = 1 standard errors from the mean (SE)) for translocated populations, 23% (± 3 SE) for recipient tortoise populations, and 19% (± 2 SE) for control populations. The percentage values are the means for each treatment group of the experimental populations and although these values would probably result in great concern among managers and scientists, the differences among the populations are not statistically discernible and are substantially smaller than the pre-determined threshold to determine success or failure. Thus one would conclude that while mortality is high, it is high in each of the treatment groups including tortoises not affected by translocation, and is probably influenced by drought conditions, or other factors acting at the scale of he entire study area.

Some response variables may be more important than others when assessing the success of the translocation. For example, translocated animals could have high survivorship, low stress, normal movement patterns, high reproduction, but slower growth rates than resident animals, and this might spur additional investigation, but relatively few changes to the program, or the determination of success. In contrast, translocated animals could have low stress, and egg production that is not different from resident populations, but could have unusually high mortality relative to resident animals. This may call for closer investigation of the sources of mortality, which could aid in adaptive management of the translocation program based on what was learned in the initial translocation efforts. It is expected that differences among the tortoise populations may result in changes in procedures during subsequent translocation efforts or a re-evaluation of our expectations.

Short Term Metrics of Success

Short term metrics that will be used as evaluation criteria for the success of translocation activities include daily, seasonal and inter-annual analyses of tortoise movements, and relevant parameters for stress, disease, survival, and possibly other parameters as listed below. This work will occur during the first three to five years of the translocation project, including the year the tortoises are moved.

Environmental variability can be substantial in desert biomes and can confound ecological research projects if not anticipated. In addition each of the response variables can have inherent natural variation that can cause differences among treatment groups to be difficult to detect. We conducted power analyses to aid us in interpreting the level of detection possible for various responses using estimates of sample sizes anticipated for this research program. We determined that a 20% mean difference in evaluation criteria would be statistically discernible in most cases and acceptable for initial evaluation criteria under most circumstances. Translocated tortoises and the residents that inhabit the recipient sites (and are thus directly impacted by the translocation) may have responses in each of the metrics listed below. For translocation to be successful, these two groups of animals should return to normal (or acceptable) levels of the response variables, when compared to control animals, measured over the short term.

Growth rates

Bodily growth rates of vertebrates are highly variable and can be affected by several factors such as nutrition, health, and age. Even healthy tortoises may show little or no growth in some years. Growth also varies between adult male and female tortoises

(Turner et al. 1987b). Growth rates can be measured by recording dimensions of the shell by using calipers, and measuring the mass of animals over time (Woodbury and Hardy 1948, Turner et al. 1987b). Due to the slow growth rate of adults, short term comparisons are probably best conducted with neonatal or juvenile animals that grow at faster rates than adults (Turner et al. 1987b). Growth of small tortoises has been reported to be more highly correlated with precipitation than annual plant production (Berry 2002). Thus, making measurements on tortoises will require the comparisons of growth between residents versus translocated tortoises in light of the variable rainfall and resulting plant production in different years. Monitoring average annual growth rates in light of plant production will address recommended research item 3.f. of the Recovery Plan, which entails measuring the nutritional and physiological ecology of different size classes of tortoises (Fish and Wildlife Service 1994, p. 54).

Differences in growth rates will be difficult to detect among adult tortoises because of their slow growth rates (P. Medica et al., *Unpublished Data*). Therefore the most important demographic group for this evaluation are desert tortoises that are pre-reproductive - generally those less or equal to than 180 mm maximum carapace length. As part of sampling in the general study area, all tortoises that are encountered should be marked and measured (not just those that are to be radio transmittered). Therefore, smaller tortoises (≤ 180 MCL) can be encountered, and these size classes are necessary to adequately document growth over time. This method of comparison requires that small size classes of tortoises be translocated in addition to adults, in order to provide comparable measures of growth among treatment groups. If growth is measured as a success criterion, repeated captures of small sized tortoises will be required for estimating growth. This will result in average growth estimates for different locations, but likely not provide annualized growth measurements unless the tortoises have radios attached.

Growth rates of individual desert tortoises in translocated populations should not be, on average, 20% different than individuals in recipient, or control populations after accounting for age, gender, and variation among sites in the amount of annual rainfall and forage availability.

Movements, site fidelity, and home range considerations

The analysis of animal movements provides a quantitative measure that integrates how desert tortoise populations relate to their habitats (e.g., availability of nutrients, and cover sites). Based on previous experiments, translocated tortoises are expected to have increased movements when compared to residents for a period of one to three years, and then they tend to “settle” into their new sites (Nussear 2004). Movements and space use by animals are calculated as a by-product of locating the animals repeatedly using radio telemetry techniques, or satellite tracking of animals. Movements of tortoises may vary in response to age/size, season, environmental conditions, reproductive status, or the availability of nutritive resources. Data on movements can be analyzed using many different methods (Turchin 1998, Doerr and Doerr 2004). For example, the maximum distance displaced, the net distance displaced, the cumulative distance displaced, and the meander-ratio of movements over time have all been used to describe movements of translocated tortoises (Field 1999, Nussear 2004). Site fidelity and home range can also be calculated from measuring multiple locations of animals over time using telemetry or similar technologies. Site fidelity gives a quantitative estimation of repeated site use over time, and is especially useful for animals that have not established home ranges (Burt 1943).

Home range is, "that area traversed by an individual in its normal activities of food gathering, mating, and caring for its young (Burt 1943)." Home range can be calculated using a number of methods including minimum convex polygons, harmonic means and kernel estimators (Worton 1987, O'Connor et al. 1994, Seeman and Powell 1996). Home ranges of tortoises can be extremely variable (O'Connor et al. 1994), and thus are difficult to compare statistically. In addition home ranges may be influenced by the amount of forage available in a given year (Fish and Wildlife Service 1994). The home range concept assumes that animals are not dispersing (Burt 1943) and therefore it has little utility for short-term comparisons of translocated animals.

Animal movements are classified according to their timing, seasonality, repeatability and associated behaviors. One important classification in desert tortoise ecology is the concept of home range (Woodbury and Hardy 1948). Previous translocation studies have indicated that tortoises moved to atypical habitat, are less likely to establish home ranges and demonstrate site fidelity than tortoises moved to areas known to be desert tortoise habitat (Nussear 2004). We predict that desert tortoises translocated to most of the proposed recipient sites will establish home ranges in the short-term, as every one of those sites that has been surveyed for tortoises does have tortoises – thus demonstrating that they are already habitat. It is expected that translocated tortoises will establish a home range and/or show site fidelity similar to that of controls the third season in the field after release. If after the third season there is greater than a 20% difference in movement parameters the topic should be considered at the annual translocation technical review meeting.

Survival rates

The desert tortoise Recovery Plan recommended research that would contribute to a comprehensive model of desert tortoise demography (recommendation 3.b), and the population dynamics of populations augmented by translocation (recommendation 3.c), as well as understanding the sources of mortality in tortoise populations (recommendation 3.b.2) (Fish and Wildlife Service 1994, p 54). One baseline population measurement that is required to model demography is a survival rate. Survival rates are quantified by quantifying survival/mortality over time by the periodic monitoring of marked individuals (e.g. monthly, and annually, or longer intervals). Survival rates may also depend on the environmental conditions of the year (Turner et al. 1984, Peterson 1994) or the cumulative effects of several years (Longshore et al. 2003). In addition to annual responses to environmental conditions, survival among different populations may depend on long-term site conditions that vary geographically. Although it can be assumed that survival rates vary from place to place, acquisition of empirical data to determine the mechanisms causing such patterns are rarely acquired. The best way to understand these variables is to compare translocated tortoises with local control populations in similar habitats.

Survivorship/mortality in desert tortoise populations can be highly variable (Table 4). The mortality of translocated and recipient animals should be similar to the control animals under similar conditions. As new and more reliable information becomes available about tortoise populations, we learn that a large amount of variation may occur in survivorship/mortality. For example, during the Clark County, NV translocation project, values of 0 and 3% mortality were measured during two years and these values are generally thought to be within the normal range for long-lived animals such as the desert tortoise. In contrast, one year there was 15% mortality among the translocated tortoises. Although considered to be a serious loss of individuals to any population, this value was not significantly different from that of the resident population and would not have crossed the threshold discussed here. However, if mortality rates for translocated animals are 20% higher than that of controls under similar conditions then the apparent causes of mortality should be investigated so that adaptive management of the translocation program can mitigate the problem.

Table 4. Mortality rates of desert tortoises

Location	**Year**	**Age Class**	**Number**	**Percent Mortality**	***Reference***
Ivanpah Valley	1980	Adults	69	4.4%	*Turner et. al., 1984*
Ivanpah Valley	1981	Adults	76	18.4%	*Turner et. al., 1984*
Ivanpah Valley	1988	Adults	10	0%	*Peterson, 1994*
Ivanpah Valley	1989	Adults	18	0%	*Peterson, 1994*
Ivanpah Valley	1990	Adults	22	41%	*Peterson, 1994*
DTNA	1988	Adults	16	19-25%	*Peterson, 1994*
DTNA	1989	Adults	24	12.5-21%	*Peterson 1994*
DTNA	1990	Adults	19	0-5%	*Peterson 1994*
Goffs*	8 year mean	Adult Males		9%	*Turner et al. 1987a*
Goffs*	8 year mean	Adult Females		6%	*Turner et al. 1987a*
Goffs*	1983-1984	Adult Males		20%	*Turner et al. 1987a*
Goffs*	1983-1984	Adult Females		11%	*Turner et al. 1987a*

* Not all tortoises at this site were transmittered animals

Stress

Abnormally high values of stress responses may be an important precursor for disease. Stress responses may also indicate something about the quality of tortoise diets or habitat quality of tortoises and is therefore an important factor to measure quantitatively. Stress hormones in desert tortoises fluctuate seasonally and differ between genders (Lance et al. 2001). Additionally short term stress can influence hormone levels in turtles and tortoises (Mahmoud et al. 1989, Lance et al. 2001). It may also be possible to document prolonged stress associated with the general condition of tortoises (Henen et al. *In Press*). Blood samples taken for disease screening could supply the volume of blood needed to conduct screening for packed cell volume, hemoglobin, and stress hormone levels, and would add much to the interpretation of the relative stress induced on animals at different release sites. This metric falls under the physiological research category (3.f) recommended in the Recovery Plan (Fish and Wildlife Service 1994, p 54).

We expect that stress differential may be measurable among translocated or recipient tortoise populations relative to controls associated with initial movement into the new area and for a period of time prior to establishing a home range. As given above, we predict that within 3 years home ranges will be established. Furthermore, after this time stress parameters should be indistinguishable between the translocatees, recipients and resident control tortoises. Should stress parameters vary by more than 20% among these groups after this time period, then the topic should be considered at the annual translocation technical review meeting.

Incidence of Disease

Research on disease and epidemiology were recommended in the Recovery Plan (Fish and Wildlife Service 1994, p 54, recommendation 3.b.1). Many animals have increased rates of illness when exposed to increased levels of stress. The incidence of disease in translocated, recipient, and control populations will be monitored by taking periodic blood samples for analysis as described above. These samples should be screened for the various pathogens that cause URTD, Herpes virus, and other diseases when definitive laboratory assays are available.

All translocation tortoises must be free of *Mycoplasma agassizii* antibodies prior to release into the recipient sites. Therefore, it is expected that conversion of translocated and recipient tortoises to a compromised ELISA status should not exceed (by > 20%) the levels of disease present in the resident control population. The percentage of resident tortoises exposed to URTD within the general translocation area is currently under study, and results will be available prior to the release of animals.

Egg production

Egg production is an important factor to measure in order to estimate the potential of the translocated populations to become assimilated into the population, and to predict their effect on demographic patterns. In addition, reproductive allocation may indicate whether physiological stressors are affecting tortoises at an ecological level. Thus egg production may be both a measure of population potential, and of ecological performance that can be an important indication of success of translocation in many scenarios. X-radiography has been used to determine clutch size and frequency in turtles and tortoises for approximately 40 years and is not thought to place adult tortoises, embryos or populations in jeopardy, however, further research into the long-term effects of this activity is still required (Hinton et al. 1997). Egg production is easily measured by taking bi-weekly x-rays of female tortoises in the field (Turner et al. 1986, Henen 1997, Nussear 2004), and to date, no ill effects have been reported to animals in these programs. In addition ultrasonography could be conducted in the fall to document the development of yolk follicles (Kuchling 1989, Rostal et al. 1994) and to reduce the need for extra X-rays in the spring. This may be especially important in interpreting why animals do not lay eggs in some years. Research on this topic would fulfill research recommendation 3.g. in the Recovery Plan (Fish and Wildlife Service 1994, p 54).

We expect that egg production among tortoise treatment groups will not differ by more than 20%.

Nest success

Research on nesting success is important to research recommendations 3.b.3 and 3.g of the Recovery Plan (Fish and Wildlife Service 1994, p 54). The second component of reproduction is a measure of the proportion of eggs that produce hatchling tortoises emerging from nests. Tortoise nests can have a high incidence of predation (Bjurlin 2001, Franks 2002), and this may be higher in areas where greater predator densities occur (Bjurlin 2001), as predator species vary, or where appropriate nesting substrates are not adequately available.

Tortoise nests can be found by attaching thread trailers to gravid female tortoises near the time when shells form on the eggs (Bjurlin 2001), or by using fluorescing powder on gravid females with hard shelled eggs (as determined using x-rays) and following this trail to the nest (Keller 1993). Once nests are located they can be monitored for hatchling success and nest predation (Bjurlin 2001). Nests may be caged to protect them from predators if necessary (Turner et al. 1986). Minimizing the number of times that a nest is visited may be beneficial in reducing the number of nests which are preyed upon. Less intrusive methods should be developed to reduce the possible impact upon nests.

We would expect that nest success would not vary by more than 20% between resident and translocated tortoises.

Recruitment

Recruitment is the measure of tortoises entering the adult breeding population (Gotelli 2001). Smaller desert tortoises are located less frequently than adult tortoises, and are thought to have higher mortality rates than adults, as is seen in most species. This may be quantified by either following juveniles as they grow to maturity, or by analyzing periodic age structure distributions over time to infer demography. Thus the methods will either involve tracking juvenile tortoises over long periods of time (which is difficult) or random field surveys of areas over regular intervals with an emphasis on finding juvenile as well as adult tortoises. Unless new technologies are developed and applied that can help human searchers find a larger portion of non-adult tortoises, this method is likely not going to be successful on its own. Wildlife detection dogs may be helpful in these surveys if they show the ability to locate juvenile tortoises. Research in this area was recommended by 3.b.3 in the Recovery Plan (Fish and Wildlife Service 1994, p 54).

Nutrition of tortoises

Nutritional ecology is an important topic when considering the management decisions that affect conservation of desert tortoises (Bjorndal 1995) and the dynamics underlying the demographics of managed tortoise populations (Nagy and Medica 1986, Henen 2002). Recent research has focused on the effects of diet and nutrition on the physiology (Oftedal et al.1995) and the nutritional ecology (Henen 2002) of desert tortoises, and on forage preferences for and nutrient contents of individual plant species (Avery 1993, Esque 1994, Nagy et al. 1998, Jennings 2002, Van Devender et al. 2002). This research collectively has demonstrated that overall nutrition and individual nutrients can influence the diet selection (Nussear et al. 1995, Oftedal et al. 2002, Tracy et al. 2003), and growth of tortoises (Oftedal et al. 1995) and that diet can influence the egg production of tortoises (Turner et al. 1986, Henen 1997, Wallis et al. 1999). However, we still lack a general understanding of the influences of degraded habitat and exotic vegetation on the diet and the physiological ecology of desert tortoises. Although, Nagy et al. (1998) indicated little or no nutritional differences between native and exotic species for a few species, as long as natives were compared to exotics that were similar in growth form and life history (i.e., annual exotic grasses compared to annual native grasses). Nevertheless it is frequently taken as fact that invasive exotics are causing nutritional stresses on desert tortoise populations (Boarman 2002a). Furthermore, these stressors may influence the physiology (Peterson 1994) and ecology (Henen 2002) of tortoises, which may increase susceptibility of tortoises to disease (Jacobson 2000, Peterson 1994), but to date these interactions remain hypotheses. If exotic grasses compete with native species, and their presence causes nutritional stress on tortoises, then tortoises subjected to eating a diet composed largely exotic species should have higher levels of nutritional stress, and lower ecological performance measures. If possible, the nutritional consequences on the physiology and ecology of desert tortoises as a result of invasive exotic plants will be investigated, as these may be relevant in the interpretation of stress, disease and reproduction in translocated tortoises. Research on these topics was recommended in the Recovery Plan (recommendations 3.e, 3.f, and 3.g, Fish and Wildlife Service 1994, p 54).

Baseline monitoring of vegetation in the tortoise habitats could support knowledge about nutritional ecology of tortoises. We suggest monitoring annual vegetation as the primary food resource for desert tortoises. If availability of forage species is equal among experimental and control populations, then it can be ruled out as a factor in other population differences.

Behavior and Social interactions

Another aspect that could be considered when studying the potential effects of translocation on desert tortoises is animal behavior, and activity (Berry 1986, Walde et al. 2004). Because tortoises spend much of their time in burrows this is especially difficult for desert tortoises (Nagy and Medica 1986). Monitoring behavior and social interactions can involve intensive monitoring of tortoises by human observers (Ruby and Niblick 1994, Ruby et al. 1994, Esque 1994, Hillard 1996) or automated telemetry systems (Walde et al. 2003). Current research using this automated telemetry over the last two years has revealed many interesting aspects of desert tortoise activity and behavior. It is unknown what impact translocation may have on desert tortoise behavior either on a daily or seasonal basis. It is suspected that translocated tortoises will be more active shortly after being moved as they search their new landscape and search out food and shelter.

Ruby et al. (1994) were unable to detect differences in behavior among animals spaced in higher stress environments under experimental conditions. While aspects of social structure and behavior may be so complex that they are difficult to quantify in a manner that facilitates statistical comparisons among populations of tortoises, there may be simpler aspects of behavior that lend themselves toward this purpose. For example comparisons of the number of agonistic interactions, sexual interactions, etc could be compared among treatment groups of tortoises. There are no current threshold levels reported in the literature upon which to gauge the variance of the expected difference in behavioral responses.

Demography

Demographic predictive models can then be used to evaluate population growth and other population parameters contributing to our overall understanding of the demographic processes for this species (research recommendation 3.b.4, Fish and Wildlife Service 1994, p 54). Life tables and predictive population models can be developed by integrating several of the parameters described individually above (e.g., generation time, egg production, recruitment, nesting success, etc.) in addition to other population metrics. This process is not sufficient to evaluate success of translocation activities alone, however, predictive models can be used to develop further hypotheses about the population dynamics of the control, translocated and recipient populations.

Long term metrics of success

Long term measures of success must be viewed and evaluated somewhat differently from short term measures. During short-term measures we focused on determining with some certainly that we have not damaged a resident population or caused undue mortality in the translocated population. Long term metrics of success should be monitored for at least one tortoise generation (i.e., 15-25 y).

Long term metrics will be measured by less intensive monitoring of animals over longer periods of time than is possible using radio telemetry. Populations should be monitored rather than individuals, and survivorship, demographic responses, and genetic samples can be collected over time to provide data the aid in the interpretation of long-term success. As previously discussed, this will require development of new techniques, at least to measure demography. Minimally, this will require intensive surveys of the translocation sites and surrounding areas to gather comparative data from undisturbed residents.

Survivorship

Long term survivorship, like short-term survivorship must be quantified by tracking a statistically relevant proportion of tortoises in experimental populations in comparison with those in control populations. Long-term survivorship can be estimated by return surveys to translocation sites (and to where translocated tortoises have dispersed to) and quantifying proportions of marked live tortoises and/or carcasses that are found. This may be accomplished using search strategies, such as intensively sampled study plots, transects randomly selected throughout the release area, or by cooperating with other survey/research efforts in the release areas. Canine-assisted teams could greatly enhance this endeavor if proven to be a viable means of tortoise surveying. Efforts to quantify long-term survivorship may be enhanced by cooperating with other monitoring efforts in the area, e.g., coordination with the Fish and Wildlife Service transect sampling that occurs in the DWMAs that are likely to receive translocated tortoises. Long term research on survivorship and factors that contribute to mortality of desert tortoises, and the long term effect of translocation on population dynamics was recommended by 3.b.2 and 3.c in the Recovery Plan (Fish and Wildlife Service 1994, p 54).

Surveys of the recipient sites and control area should be conducted regularly over the long term. On these surveys, live and dead tortoise should be encountered and measured for several parameters (e.g., growth, presence/absence of disease, genetics, etc.). Tortoises that were marked during the short-term phase of the translocation study will be especially useful in determining the long term survivorship among groups of tortoises identified in the short term. Thus if there is not differential survivorship (by 20%) among the treatment groups, as measured over the long-term, then we may judge translocation to be successful.

Demographics

Demography is the study of the population characteristics and integrates several of the parameters measured in the short-term monitoring program. For example, demographics includes population size, growth, density, distribution, size class distributions, and vital statistics such as generation time, reproductive rates, recruitment rates, mortality rates, and rates at which individuals move from one size class to another or among populations (Gotelli 2001). Research on demographics (3.b.4) was recommended by the recovery plan for this species (Fish and Wildlife Service 1994**,** p 54). Comparisons of the demographics of populations augmented by translocation, and in local control populations would aid in the determination of the long-term success of translocation. To have a complete understanding of demographics over the long-term, the short-term metrics that collectively define demography must be quantified.

Demographic parameters are not measured in the same way as other criteria. A healthy or growing population of desert tortoises is expected to be characterized by stable or increasing numbers of reproductive individuals. Generally, reproduction occurs in desert tortoises greater than or equal to 180 mm MCL. There is no empirical evidence for the demographic pattern in healthy desert tortoise populations since most of those populations for which there are population profiles are in decline. Additionally, we do not currently have the ability to confidently estimate the demographic profile for tortoises of non-reproductive sizes because these animals are difficulty to find reliably and repeatedly.

We will only be able to quantify such patterns if we develop techniques for monitoring small size classes of desert tortoises. This depends on new and innovative techniques that are yet to be discovered.

Genetics

Genetic techniques may assist in documenting the long-term success of translocation by documenting whether genetic material from translocated tortoises appears in future generations. This could indicate the relative contribution of translocated individuals to the reproduction of augmented populations. This technique requires that blood samples be taken for both the translocated animals, and for individuals in the resident control populations, and that the populations be sampled after sufficient recruitment has occurred. Analyses should be conducted to determine whether discernible differences exist among animals from the expansion area (prior to translocation) and in the control populations at the translocation sites. If such differences are not discernible, then analyses at the level of paternal and maternal lineages would be required to meet the evaluation criteria. There may be more definitive analyses available to researchers in the future and we recommend that samples be banked to take advantage of that possibility.

Genetic evidence of success would provide evidence that the translocated tortoises and recipient populations had successfully assimilated by producing new tortoises of mixed parental lineages in the proportions that translocated tortoises were used to augment the population. Research on the genetics of tortoise populations was recommended (3.b.4) by the Recovery Plan (Fish and Wildlife Service 1994, p 54).

Success in relation to genetic parameters should indicate that the translocated tortoises have been fully assimilated into the recipient population. Assimilation can be measured among populations by comparisons of alleles from the translocated animals, and those in the recipient populations over time. If rare alleles are present in the translocated tortoises and they begin to appear in hatchling or subadult tortoises in the general translocation area over time, then this metric can be used to demonstrate that the translocated tortoises are contributing reproductively to future generations of tortoises. Other parameters may be estimated using genetic analyses, such as effective population sizes, migration rates, etc. These and other metrics should be explored to provide evidence of the integration of translocated tortoises into recipient populations

Translocation of Tortoises into Die-off Areas

The Biological Opinion and the Recovery Plan (Fish and Wildlife Service 2004 and 1994, respectively) suggest using translocated tortoises to repopulate areas that have experienced die-offs in tortoise populations, or reclaimed habitat with depressed tortoise populations (such as land along unfenced highways). While initially compelling, this management action is not without risk and the possible implications of this action should be considered in depth (Frazer 1992). This is because the causes of the die-offs that have occurred at several locations across the West Mojave are currently unknown. In fact, many populations that have been monitored for decades are still declining despite ten years of increased conservation management (Tracy et al. 2004). This suggests that the suite of impacts that are causing tortoise populations to decline are still present (Frazer 1992). Thus, in addition to the stresses associated with translocating animals, those released into die-off areas will likely be submitted to other, as yet, unknown or unquantified stress factors. When multiple factors are suspected of causing population declines (e.g., road mortality, versus invasive species, versus some unknown contaminate) it is difficult to design experiments that include all possible factors and simply observational studies are unlikely to reveal these multi-factorial relationships. Translocations into areas that have experienced, or are currently experiencing, die-offs should be done so in an experimental context in order to ensure that the impacts to the natural population in that area can be identified and eliminated (Tracy et al. 2004). The short- or long-term success of any experimental release of tortoises into these areas may depend greatly on the discovery of additional stressors, and learning what management actions can be enacted to alleviate them. In order to quantify the myriad of interacting impacts that are likely to influence tortoise populations, researchers must quantify as many impacts as possible. The following paragraphs provide consideration of several potential impacts (but not an exhaustive list) that should be quantified (in addition to the short- and long- term metrics off success that apply more generally) if we are to understand what is causing die-offs in these areas. As potential impacts are identified and characterized, management actions will be developed and implemented to reduce the magnitude of those impacts

Predation

Predation upon desert tortoises and their nests has been documented for a number of species vertebrates as well as invertebrates, these include but are not limited to: kit foxes, badgers (Coombs 1977), coyotes (Berry and Woodman 1984b, and Hohman and Ohmart 1980) bobcats, skunks, ringtails (Coombs 1977 Grover and DeFalco 1995 and Luckenbach 1982) Gila monsters (Hensley 1950) coachwhip snakes (Luckenbach 1982) golden eagles (Luckenbach 1982) ravens (Boarman 2002a) and even ants, (Goodwin et al. 1995).

There are several ways to measure predation by monitoring possible predators. First, increased monitoring of adult tortoises, their nests and non-adult tortoises over the course of several years will likely provide additional information about sources and rates of predation. Predation potential could be measured by direct methods using mark recapture estimates of predator density, or by indirect methods such as using cameras triggered by the animals (Karanth 1995), or track stations (Ng et al. 2004). These methods will not indicate the probability of predation, but would be sufficient to enumerate the relative population numbers of potential predators that are present at different release sites. Correlations between the numbers of predators, and predation events would have to be documented. Research on sources of mortality, including natural predation is recommended by the Recovery Plan (research recommendation 3.b.2, Fish and Wildlife Service 1994, p 54).

Ravens are known to prey on juvenile tortoises (Esque and Duncan 1985, Boarman 1993). The recent increases in raven population sizes in the southwestern US have caused their potential impacts to tortoises to be a concern to management (Boarman 2002b). Relative impacts by ravens at different sites have been quantified using small styrofoam tortoises as an indicator of potential predation levels (Kristan and Boarman 2003). Other than ravens, the incidence of predation on tortoises is mostly unquantified. This is because it is difficult to provide causal evidence of tortoise mortality when the evidence is based mostly on carcasses. Still a few studies provide some insight into predation on adult tortoises (Woodbury and Hardy 1948, Peterson 1994, Nussear 2004, P. Medica, *Personal Communication*). These studies indicate that large predators (e.g., *Felis concolor* and *Canis latrans*) are capable of preying on adult tortoises, and that predation levels may be related to the climatic conditions in the habitat.

Roads/habitat fragmentation and human impacts

Paved and unpaved roads and routes have the potential to impact tortoises directly and indirectly (Stebbins 1974, Bury et al. 1977, Boarman 2002a, Tracy et al. 2004). Recent inventories and analyses indicate that the number of roads and routes have increased in the west Mojave, including the areas being considered for translocation of animals in this plan (Tracy et al. 2004). These roads (whether designated open or closed) are a prominent feature on the landscape, and must be considered in any experimental design or analysis of short and long term success measures for translocation. There are literally hundreds of metrics to evaluate landscape patterns of these features. They can be grouped however, according to the aspect of landscape pattern measured: area/density/edge, shape, core area, isolation/proximity, contrast, contagion/interspersion, connectivity, and diversity (McGarigal et. al. 2002). Linear network pattern analysis may be particularly useful, and a whole variety of metrics have been developed (Forman 1995). While not an exact measurement of fragmentation, road density is often used as a surrogate for fragmentation. Road density measures the number of miles or kilometers of roads per unit area. In addition to road density, other quantitative metrics for evaluating landscape fragmentation should be considered, such as mean patch size, number of patches, edge density, landscape shape index, etc. These measures may be correlated with changes in the composition of native perennial plant communities, as well as changes in the relative presence of exotic and native annual plants which may in turn have influences on the diets of tortoises. These potential correlations and other possible influences of roads on tortoise populations should be investigated further.

Roads increase access to desert environments thus potentially increasing other human impacts such as poaching, plinking, attacks by feral dogs, and the releases of pet tortoises may also be correlated with the prevalence of roads in the desert. Major roads may also cause additional impacts such as pollution from vehicles, corridors for the dispersal of invasive exotic species, etc. Impacts of pollution (either direct or indirect) on tortoise populations have not been studied, but should not be overlooked given that the sources of decline have not been identified in these depleted populations. Research on the impacts of roads and other disturbances is recommended by the Recovery Plan (3.c, Fish and Wildlife Service 1994, p 54).

Invasive species and fire

Invasive species have been discussed in reference to their potential affect on tortoise diets. However, an immediate and well-documented relationship is that between invasive species and desert fires. Desert fires affect tortoise populations directly by fire related tortoise mortality and indirectly by long-term habitat changes associated with fire (Brooks and Esque 2003, Esque et al. 2003, Esque 2004).

VII. Site Characterization of the Expansion Areas and Translocation Sites

Habitat Variables and Models

Previously, the use of an expert-opinion habitat model was described for its role in the decision support model. The expert-opinion habitat model already demonstrated its value in the decision making process, however, this should not be confused with a quantitative habitat model. Reliable quantitative habitat models are not currently available for desert tortoises, although research groups are currently developing such models (Gass et al. 2004, Mary Cablk, Desert Research Institute, *Personal Communication*).

Climate, soils, and vegetation are all interrelated in Mojave Desert ecosystems and are important to characterization of the expansion and recipient sites because they are primary factors likely to affect desert tortoise populations. Climate is linked to the health of tortoises and tortoise populations in a variety of ways. For example, it has been shown that the growth of juvenile tortoises is directly related to availability of precipitation (Medica, et al. 1975), while adult tortoises may show adverse responses to prolonged drought (Peterson 1994, Longshore et al. 2003). Indirectly, the timing and amount of precipitation affects the production of Mojave Desert annual plants (Went 1948, Beatley 1974) which are important foods for the desert tortoise (Hansen, et al. 1976, Nagy and Medica 1986, Avery 1993, Esque 1994, Jennings 2002). Climatic data are valuable for the interpretation of ecological pattern, especially for long-lived desert plants and animals (Beatley 1974, 1980). Climate data will be recorded at translocation sites. The climate stations may record precipitation, temperature, and wind speed among other variables.

Vegetative cover also varies with the amount of annual precipitation (Beatley 1974) and may vary widely with climate fluctuations (Webb et al. 2003). Vegetation provides cover from predators and climatic extremes, as well as, nutrition for tortoise populations (Woodbury and Hardy 1948, Luckenbach 1982). Perennial vegetation communities may be evaluated at least to the level of vegetation association. Annual vegetation may be mapped in relation to soil surface patterns and historic surface disturbances.

Classification of soil surfaces can provide a means to understand mechanisms underlying ecological patterns (Webb and Wilshire 1980). Soil type, parent materials and the relative amount of calcium carbonate hardpan in the soil subsurface may be used to characterize release areas for later analysis in combination with data on vegetation and soil surface disturbances. Soil friability and depth may affect the amount of cover or nest sites available to tortoises (Wilson 1989, Merkler and Lato 1999). Permeability and composition of soil surfaces may affect the availability of drinking sites for tortoises (Medica et al. 1980). Chemical composition of soils may provide tortoises with mineral nutrients (Marlow and Tollestrup 1982, Esque and Peters 1994). Soil classifications may be instrumental in understanding soil nutrients in relation to desert tortoise food plants and possibly soil toxicants that could become a factor in the health of desert animals in locations where the soils are disturbed. The Mojave Desert is one of the most poorly mapped areas in the lower 48 states with respect to soil surface maps. Soils surveys or geomorphology may be mapped for all of the expansion area and recipient sites. Research on the spatial variability of climate and productivity of vegetation and the relationships with population parameters was recommended by the Recovery Plan (3.e, Fish and Wildlife Service 1994, p 54).

Land Use and Surface Disturbances

Land use and surface disturbances can affect desert tortoise populations and individuals and should be considered the monitoring program. Land uses that result in surface disturbances and may affect tortoises include: urbanization, agriculture, military operations, mining, livestock grazing, feral animals, utility corridors, and a variety of recreational uses such as OHV, mountain bikes (Berry 1984, Bury and Marlow 1973, Bury, et al. 1977, Fish and Wildlife Service 1994). Research on the effects of disturbance on tortoise populations is recommended by the recovery plan (3.c, Fish and Wildlife Service 1994, p 54).

VIII. Permit Items

It is anticipated that the following activities will require permits from the USFWS and the California Department of Fish and Game. Some of these items will need approval for both resident and translocated tortoises.

- Survey for tortoises with canine-assisted teams
- Survey for tortoises with human teams
- Capture tortoises
- Tap tortoises out of burrows
- Handle tortoises
- Incidental take with harm of minimal numbers of tortoises
- Attach radio transmitters
- Attach dataloggers
- Handle tortoises to download dataloggers or to change out transmitters
- Weigh tortoises
- Measure tortoises (carapace and plastron width and height with calipers)
- Mark tortoises (PIT tag, notching of marginal scutes, attaching external numbers, and painting of dots or numbers on the carapace)
- Track tortoises using radio telemetry
- Draw blood, inspect for disease, submit blood for laboratory analysis, genetics analysis, and stress analyses. Blood can be drawn from humeral or jugular punctures, toenail clipping. Analyses for toxicology, or stable isotope ratios may be possible using the nail clippings.
- Translocate tortoises – this will involve retrieval of tortoises from the field, possible excavation of animals from their burrows. Transporting animals to vehicles or aircraft. Transporting animals to translocation sites. Hydration of animals by providing drinking water, and release of animals at translocation sites in the spring, fall and winter
- Hold juvenile tortoises in fenced pens
- Hold adult tortoises in fenced pens
- Assess reproduction – this will involve x-radiography or ultra-sound scanning animals at least bi-weekly.
- Assess nesting success – this will involve the attachment of thread trailers and/or fluorescent powder, marking of nests, excavation and measurement of eggs, caging of nests prior to hatching, and measuring/bleeding of hatchlings for genetics and health surveys.
- Collection/salvage and marking of shells of deceased animals
- Salvage of moribund animals for possible necropsy
- Collection of scats for analysis
- Trapping of predators
- Marking of burrows with numbered tags
- Conduct behavioral studies
- Use fiber-optic scopes, or similar methods to look in burrows for tortoises
- Place meteorological monitoring equipment on the landscape to monitor weather conditions
- Place antenna towers on the landscape as part of an automated telemetry system

X. Time Line of Activities

Fall 2004

Evaluation of potential recipient areas

Spring 2005

Interagency agreements, i.e., NEPA, land uses and right-of-ways
Apply for State and Federal permits
Apply for animal care and use committee approval
Order equipment (transmitters may take 6 month prep time)
Fencing plans in place for conservation research area
Telemeter residents in the recipient sites and begin monitoring them
Collect baseline environmental data on SEA and recipient sites
Build Juvenile tortoises holding pens

Fall 2005

Begin K9/human surveys / radio attachment / blood work at SEA
Fence construction along release area borders
Place Juvenile tortoises in holding pens
Annual Review with Conservation Mitigation Working Group

Spring 2006

Continue clearance surveys / radio attachment / blood work at all SEA recipient sites
Complete tortoise containment fences (i.e. highway fencing, boundary fences for conservation areas, etc. as needed for experiments
Begin translocating tortoises from SEA if possible

Fall 2006

Last chance to complete surveys of SEA
Continue translocation of animals from SEA
Annual Review with Conservation Mitigation Working Group

Spring 2007

Complete translocation of all tortoises from the SEA

July 2007

Military training activities begin in SEA

Fall 2007 and beyond

Assessment of short-term effectiveness monitoring plan for SEA tortoises

Adaptive planning for Superior Valley
Surveys and marking of Superior Valley tortoises and resident tortoises
Annual Review
Clearances of Superior Valley and translocate to recipient area

2010

Military training begins in Superior Valley

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Appendix 1. Guidance on Translocations Provided by the Desert Tortoise Recovery Plan

The Desert Tortoise Recovery Plan (Fish and Wildlife Service 1994, Appendix B) contains specific recommendations for translocation of desert tortoises that are relevant to this plan (K. Berry – *Personal Communication* August 2004) and are addressed herein. The seven guidelines from the Recovery Plan are given below, and they provide cautions that the Recovery Team recommended for translocation projects. However, these guidelines have little possibility of all being applied simultaneously due to a lack of data for many metrics such as carrying capacity and population trends (Tracy et al. 2004:19-25). In addition new and relevant research has been conducted that provides new information on translocation of desert tortoises, and it has been recommended that these guidelines be revisited (Tracy et al. 2004:19-25). We discuss possible considerations and limitations that may be imposed on translocation efforts by the strict adherence to these guidelines. Where possible these guidelines have been followed.

Guideline 1.

"Experimental translocations should be done outside experimental management zones. No desert tortoises should be introduced into DWMAs [Desert Wildlife Management Areas]—at least until relocation is much better understood."

The Recovery Plan for the desert tortoise is the basis and key strategy for recovery and delisting of the desert tortoise. The Recovery Plan divides the range of the desert tortoise into six distinct recovery units and recommends the establishment of 14 desert wildlife management areas (DWMAs) throughout the recovery units. Within each desert wildlife management area, the Recovery Plan recommends implementation of reserve level protection of desert tortoise populations and habitat, while maintaining and protecting other sensitive species and ecosystem functions.

The Recovery Plan recognized both the potential merits and dangers associated with translocation of tortoises. For example, while the first guideline recommended not releasing translocated tortoises into DWMAs, the guideline itself, and other references in the Recovery Plan suggest this would be an accepted strategy once translocation was understood in greater detail (e.g., Fish and Wildlife Service 1994, p. 45). Indeed, translocation of tortoises into several DWMAs was prescribed as recommended research (Fish and Wildlife Service 1994, pages F21, F30, and F36).

Tortoises translocated due to the expansion of Ft. Irwin will require fairly large protected areas due to the numbers of tortoises thought to inhabit the expansion areas. If these animals are to be assured long-term protection, then successful conservation management will require that the tortoises be placed in an area currently designated as a DWMA (Fish and Wildlife Service 1994), or in other areas that would have to be dedicated to tortoise conservation. To our knowledge the DWMAs are the only suitable large tracts of land that are available for translocation that afford long-term protection to translocated tortoise populations. If tortoises are not moved into DWMAs their chances for long-term survival may be reduced, compromising the conservation value of the translocation, unless long-term conservation agreements can be established for other areas.

Guideline 2.

"All translocations should occur in good habitat where the desert tortoise population is known to be substantially depleted from its former level of abundance…"

The second guideline requires knowledge of historical abundance of tortoises, and the attributes that constitute "good tortoise habitat". There has been considerable analysis of the status of desert tortoise populations throughout the range of the listed species. It is clear from these analyses that there have been serious declines on several permanent study plots throughout the Mojave Desert and in areas peripheral to Ft. Irwin in particular (Berry and Medica 1995, Karl 2002, Berry 2003, Tracy et al. 2004). The extent to which we can reliably extrapolate information from permanent study plots to larger populations is debatable (Tracy et al. 2004), but it is generally agreed that we do not have sufficient information to document population trends throughout the Western Mojave bio-regional planning area. Thus, there is no reliable way to guarantee that any site selected to translocate desert tortoises would meet the guideline. However, the consistency in population declines among study plots in the West Mojave Recovery Unit suggests the numbers of animals throughout much of the planning area are well below densities that existed in the 1970s and 1980s. To the extent possible, areas of suspected declines (e.g., along formerly unprotected highway rights-of-way, or die-off areas) should be used experimentally, as the causes for the declines are still unknown (Frazer 1992, Tracy et al. 2004).

While many tortoise biologists have a general concept of what constitutes "good tortoise habitat" this has not been quantitatively documented in the peer-reviewed literature. Thus, other than heuristic examinations of the habitat, little can be done to guarantee that a given area is "good tortoise habitat".

Guideline 3.

"Areas into which desert tortoises are to be relocated should be surrounded by a desert tortoise-proof fence or similar barrier..."

The proposed recipient sites are within a large geographic area that will be bounded by tortoise-proof fences (e.g. along the southern boundary of the SEA, and the northern boundary of Interstate 15) or other effective boundaries (e.g., mountain ranges and playas) that should contain the translocated tortoises. In addition, tortoises may be released into smaller experimental pens within the larger area. Final determination of the fencing requirements for this plan requires coordination among several agencies (e.g., the Fish and Wildlife Service, the California Department of Fish and Game, the Bureau of Land Management, California Transportation Department, and the U. S. Army).

Guideline 4.

"The best translocations into empty habitat involve desert tortoises in all age classes, in the proportions in which they occur in a stable population…"

Search efforts will include efforts to locate tortoises of all size-classes. The numbers of juvenile tortoises that are encountered will likely depend on the climate for the last several years, and the method that is used during the majority of the clearances. Juvenile tortoises will be released at each of the recipient sites as they are available. This will result in a relatively even dispersion of animals throughout the recipient sites. Juveniles that are released will be monitored in order to quantify aspects of the short term goals that apply to smaller sized classes of animals. Research that focuses on juvenile tortoise issues may be a more efficacious use of juvenile tortoises (Doak et al. 1994).

Guideline 5.

"The number of desert tortoises introduced should not exceed the pre-decline density (if known). If the pre-decline density is not known, introductions should not exceed 100 adults or 200 animals of all age classes per square mile … "

Reliable estimates of desert tortoise densities (especially historic estimates) are available for few sites in the Mojave. It is unlikely that the sites that meet other translocation criteria will have empirically known "pre-decline" densities. Research on the effects of density on desert tortoise ecology has been conducted by the USGS and UNR in several semi-natural tortoise enclosures. Possible density effects on growth were observed at densities greater than 500 - 800 tortoises per sq. km (Saethre et al. 2003). We have considered historic densities and results from recent experiments to aid in determining target densities for proposed tortoise translocation sites. Adult tortoises will be translocated in small groups (e.g., 50-70 /sq. mi) to many different translocation sites in order to disperse them throughout the release areas. Recent density surveys for the Superior-Cronese DWMA estimate approximately 7.5 tortoises per sq km (P. Medica *Personal Communication*). Thus, given these densities, the number of adult tortoises is not expected to exceed densities of 100 per square mile after translocation.

Guideline 6.

"All potential translocatees should be medically evaluated in terms of general health and indications of disease, using the latest available technology, before they are moved. All translocatees should be genotyped unless the desert tortoises are to be moved only very short distances or between populations that are clearly "genetically" homogeneous. All translocated animals should be permanently marked, and most should be fitted with radio transmitters so that their subsequent movements can be closely tracked."

Thorough medical screening of all tortoises will be conducted prior to translocation. At the time of medical examination, sufficient samples will also be taken for genetic analysis.

Genetic analyses with sufficient resolution to distinguish differences among populations in the West Mojave Recovery Unit have not been conducted, although this is a subject of current research. Therefore the recipient sites suggested for translocation are in the DWMAs adjacent to expansion areas when possible.

All animals that can accommodate a transmitter with a battery life of at least 1 year (i.e. transmitter package must be less than 10% of the tortoise body mass) will have radios attached prior to translocation during clearance surveys. Animals too small for the radios will be moved to holding structures designed for the containment of juvenile tortoises during clearances (e.g., the FISS enclosures, Hazard and Morafka 2002). All animals will be marked with an external number, have a PIT tag affixed to the carapace, and may be notched as permitting allows.

Guideline 7.

" If desert tortoises are to be moved into an area that already supports a population—even one that is well below carrying capacity—the recipient population should be monitored for at least 2 years prior to the introduction. Necessary data include the density and age structure of the recipient population, home ranges of resident desert tortoises, and general ecological conditions of habitat.

Areas along paved highways can serve as good translocation sites, if properly fenced…"

A thorough evaluation of the physical parameters of recipient sites will be conducted, as well as, a population and health survey of resident tortoises prior to translocation. The timeline and the urgency of the Ft. Irwin expansion into the SEA may not permit a full two-year study of resident populations in the recipient sites for the SEA tortoises before translocation must occur.

The sites selected resulted from a decision support process that included scenarios that considered major roads in both fenced and unfenced status. In scenarios where major roads were considered to be fenced, the model identified possible recipient sites near roads.

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Appendix 2. Minimum Requirements for the Translocation Plan

Established in the Biological Opinion

Fish and Wildlife Service. 2004. Biological opinion for the proposed addition of maneuver training lands at Fort Irwin, California. BO# 1-8-03-F-48, March 15, 2004.

The translocation plan was to provide information on:

a. The methods used to collect, hold, transport, and release tortoises at translocation (recipient) sites.

These methods are described in the *Translocation Procedures* section of the Translocation Plan.

b. A procedure on how to determine appropriate translocation sites.

The USFWS recommended that a GIS-based model be used to identify recipient sites for the placement of translocated tortoises (D. Threloff, USFWS – *Personal Communication*).

Scientists at the USGS, the Redlands Institute and the University of Nevada, Reno (UNR) collaborated on the development of a geographical decision support model to provide an objective tool for the selection of recipient sites for translocated tortoises. The model combined data on attributes and expert-opinion about tortoise habitat, threats to tortoises, recent tortoise surveys and important anthropogenic factors (e.g., land ownership, road status, projected urban growth) that were available through a variety of sources. This model was used to construct several scenarios of the suitability of lands in the west Mojave Desert for translocation of tortoises. These scenarios were developed to identify acceptable translocation sites based on multiple criteria, such as population die off information (see below), land ownership attributes, habitat suitability, level of habitat disturbance, and accessibility by the public, and the presence of major roads (with fenced and unfenced scenarios). These scenarios were presented to the Conservation Mitigation Working Group, so that a final consensus on the most suitable sites for translocation could be achieved. The results of that decision are presented in the Translocation Plan as the areas proposed for translocation activities.

c. The personnel who would be involved in the mechanics and research monitoring related to translocation.

It is expected that there are many scientists that will be participating in different aspects of the translocation during the expansion of Ft. Irwin. The Conservation Mitigation Working Group determined that this plan would be limited to the selection of translocation sites, the movement of the tortoises, and a description of the criteria that may be used to measure short- and long-term success of this translocation. After the initial tasks of translocation, research will be conducted that is focused toward monitoring efficacy of the activities that are part of this plan. We cannot foresee all possible personnel or projects that will be involved in the translocation activities.

However all personnel working with tortoises will have appropriate experience and training as required by the permitting agencies.

d. The procedures for determining the health of the desert tortoises and for the disposition of unhealthy animals.

The health status of tortoises will be evaluated prior to and after translocation in accordance with goals of the short- and long-term monitoring programs. The procedures of determining the health status of translocated and resident animals affected by the Ft. Irwin expansion and the disposition of diseased animals is discussed in detail in the *Health Screening and Translocation of Diseased Tortoises* section of the translocation plan.

e. The methods that will be used to manage and protect the translocation sites.

Three types of recipient sites may be used for translocated tortoises. 1) Sites with extant tortoise populations will receive some of the tortoises with minimal restrictions, 2) sites with extant tortoise populations, depressed populations, or extirpated populations may receive a portion of the translocated animals as experimental releases, and 3) smaller fenced sites may be used for manipulative experiments or to segregate diseased individuals in groups. In addition there will be control sites where residents are not manipulated beyond monitoring the metrics identified in the short- and long-term goals, but where translocated tortoises are not present. Specific instructions about how translocation sites will be protected are provided in the section called, “Protection of Translocation Sites”.

f. A method of determining when desert tortoises would be moved across the southern boundary fence or to a more distant translocation site.

Methods of determining when tortoises are to be moved across the southern boundary fence or distant translocation sites are described above in the section entitled, “*Determining when desert tortoises would be moved across the southern boundary fence.”*

g. A description of any radio transmitters, data recorders and PIT tags that may be used.

The descriptions of the radio transmitters, or data recorders (loggers) that will be attached to tortoises, and PIT tags that will be used to mark tortoises are discussed in the SEA Clearance - Tortoise Procedures section of the Translocation Plan.

Appendix 3. Detailed Description of the Decision Support Model

Redlands Institute: Thomas Leuteritz, Paul Burgess, Frank Davenport, Nathan Strout

Base Data

Public Land Survey System (PLSS)

The Public Land Survey System (PLSS) was used as the standard management unit for all geoprocessing analysis. All model criteria was generalized to the section level as defined by the PLSS.

Source Data

Public Land Survey System (PLSS)*, published January 1999, 1:100,000*
California Spatial Information Library, Sacramento, CA
http://gis.ca.gov

Abstract
The 'PLSFILL' layer is a polygon coverage depicting the township, range and sections contained in the Public Land Survey System grid for the State of California. Townships are roughly six miles square, and are numbered North and South from an established baseline. Likewise, ranges are numbered east and west from an established meridian. This grid is then subdivided into 36 one square-mile (640 acre) sections. California uses three baseline/meridians, these being Humboldt, Mt. Diablo, and San Bernardino, abbreviated H, M, and S.
Meridian, township, range, and section values are combined in the redefined item MTRS to facilitate relates.

Processing Steps

The Public Land Survey System (PLSS) source data was altered to clip the source data to the study area as well as construct abstract sections for analysis in a previously un-sectioned area of the northeast the study area – the West Mojave Planning Unit (WEMO). These abstract sections were assigned a meridian of 9, all other attributes were assigned appropriate township, range, and section field values based on the standard PLSS numbering practices. Therefore, these sections may be identified by a value of 9 in the “Meridian” field as well as in the first character of the “MTRS” field.

Criteria

Urban Areas

Purpose

Tortoise habitat is degraded and human disturbance is high within or close to urban areas. Therefore translocating tortoises away from urban areas is more favorable.

Source Data

***U.S. Census Urbanized Areas**, published March 2000, 1:100,000*
ESRI http://arcdata.esri.com/data/tiger2000/tiger_county.cfm?sfips=06

Abstract

U.S. Census Urbanized Areas represents the Census 2000 Urbanized Areas (UA) and Urban Clusters (UC). A UA consists of contiguous, densely settled census block groups (BGs) and census blocks that meet minimum population density requirements (1000ppsm /500ppsm), along with adjacent densely settled census blocks that together encompass a population of at least 50,000 people. A UC consists of contiguous, densely settled census BGs and census blocks that meet minimum population density requirements, along with adjacent densely settled census blocks that together encompass a population of at least 2,500 people, but fewer than 50,000 people. The dataset covers the 50 States plus the District of Columbia within United States.
An urbanized area (UA) consists of densely settled territory that contains 50,000 or more people. A UA may contain both place and nonplace territory. The U.S. Census Bureau delineates UAs to provide a better separation of urban and rural territory, population, and housing in the vicinity of large places. At least 35,000 people in a UA must live in an area that is not part of a military reservation.
For Census 2000, UA delineations constitute a "zero-based" approach that requires no "grandfathering" of UA boundaries from the 1990 census. Because of the more stringent density requirements (and the less restrictive extended place criteria), some territory that was classified as urbanized for the 1990 census has been reclassified as rural. In addition, some areas that were identified as UAs for the 1990 census have been reclassified as urban clusters.

Processing Steps

A distance analysis was done to find the distance of the center of each PLSS section from the boundary of the nearest urban area. This was accomplished by developing a geoprocessing model that:
Generated a point feature class of the midpoints of each section

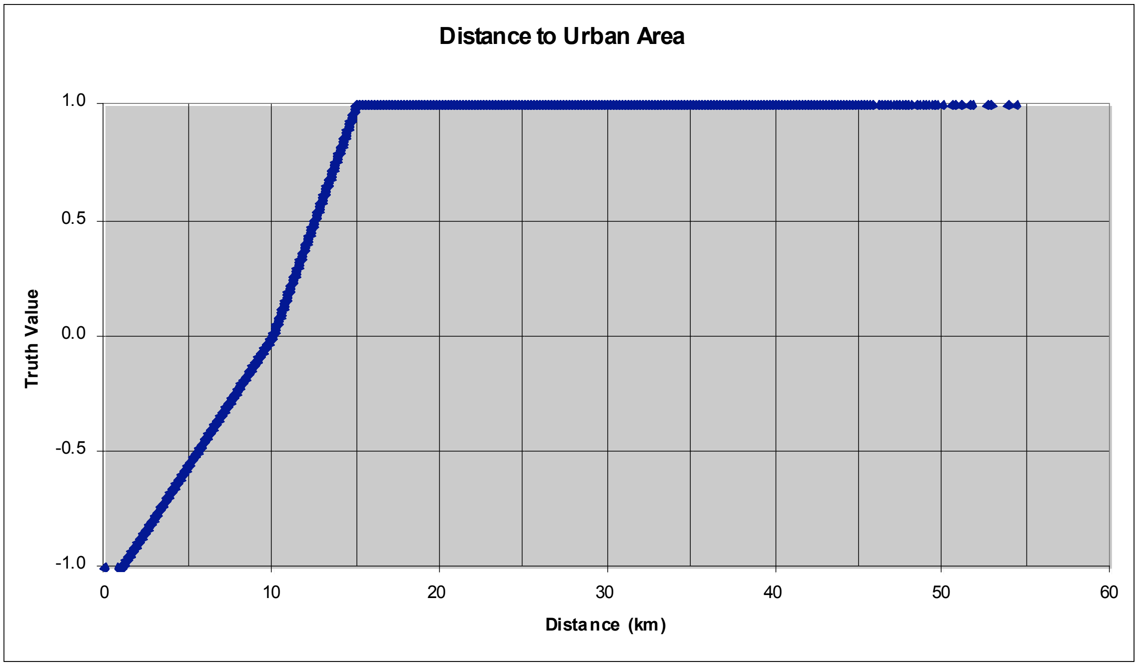
1. A NEAR analysis was used to determine the distance from the midpoint to the boundary of the nearest urban area.

2. The distance results of the point feature class were joined back to the PLSS polygon feature class to reestablish geometry.

3. The results were then joined to a master criteria shapefile using the MTRS as the join item.

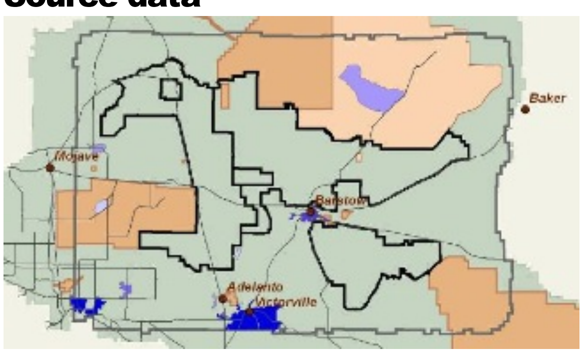
Parameters

Model truth values increase as distance to urban areas increases.

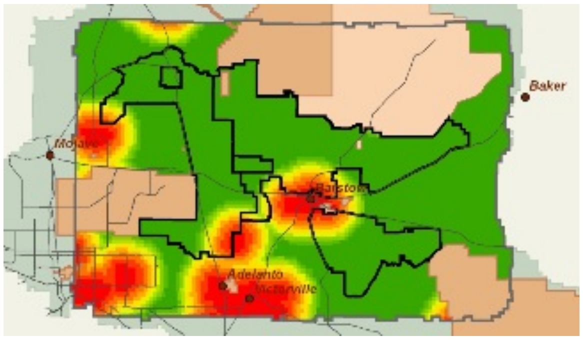


- Sections within 10 kilometers of an urban area were assigned negative truth values on an ascending scale
- Sections between 10 and 15 kilometers from an urban area were assigned positive truth values on an ascending scale
- All sections greater than 15 kilometers from an urban area were assigned a truth value of +1.

Source data



Results



Genetic

Purpose

Since the genetics for Desert Tortoises are not well known it is better to keep translocated tortoises closer to their source population than further away.

Source Data

Ft. Irwin NTC boundary, published May 1998, updated 2003, 1:100,000
DOD Ownership: Mojave Desert Ecosystem Project (MDEP)
http://www.mojavedata.gov/home.html

Abstract
This dataset was extracted from the larger Mojave Desert land ownership database provided by the BLM and compiled by Utah State University. The data contained in this database includes polygons for DOD owned land only.
The original linework was updated to reflect the final expansion boundary. In October 2000, extended negotiations between DA and DOI resulted in a DA/DOI agreement on proposed legislation that would determine boundaries of a western expansion area of Fort Irwin. This legislative proposal is a culmination of discussions in which the Army modified its training land requirements to avoid use of Paradise Valley, the most sensitive desert tortoise habitat. Under this new concept, the Army would seek the use of about 133,000 additional training acres, which includes approximately 22,000 acres of Fort Irwin land that is not currently used for this purpose, plus 46,438 acres east in Silurian Valley and 63,673 acres west in Superior Valley.

Processing Steps

A distance analysis was done to find the distance of the center of each PLSS section from the boundary of Fort Irwin. This was accomplished by developing a geoprocessing model that:

1. Generated a point feature class of the midpoints of each section

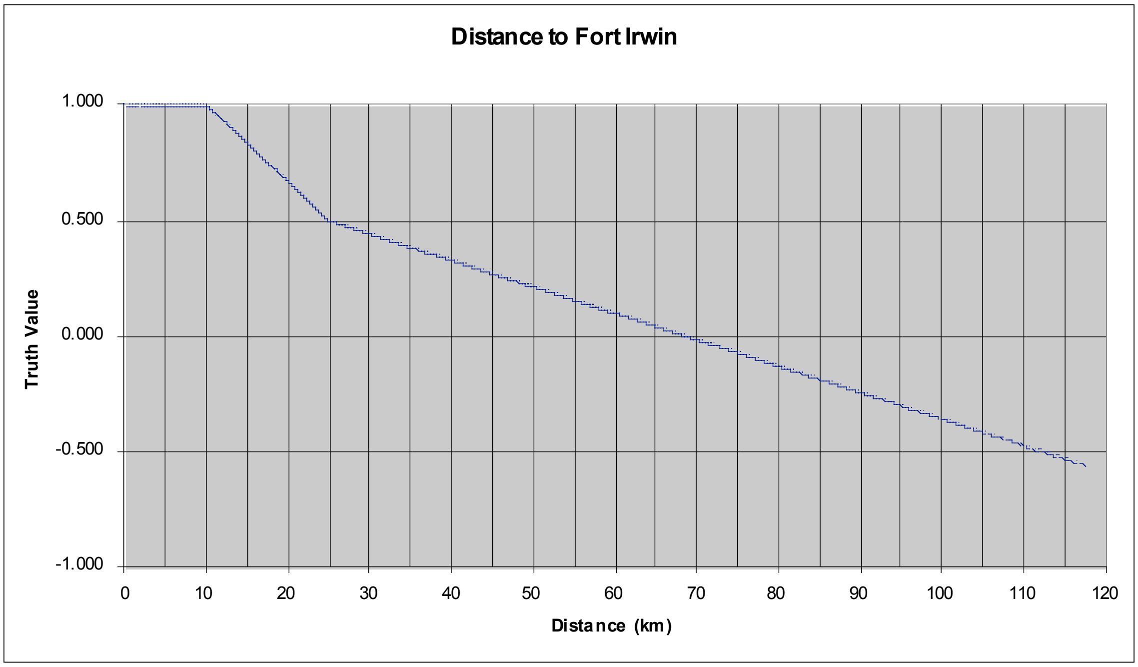
2. A NEAR analysis was used to determine the distance from the midpoint to the Fort Irwin boundary.

3. The distance results of the point feature class were joined back to the PLSS polygon feature class to reestablish geometry.

4. The results were then joined to a master criteria shapefile using the MTRS as the join item.

Parameters

Model truth values decrease as distance to Fort Irwin increases.

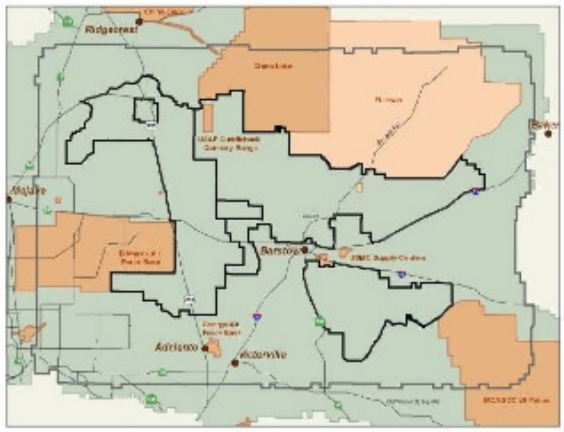


- All sections within 10 kilometers of Fort Irwin were assigned a truth value of +1

- Sections between 10 – 25 kilometers from Fort Irwin were assigned values of +1 - +0.5 on a decreasing scale.

- Sections greater than 25 kilometers from Fort Irwin were assigned values of +0.5 - -1 on a descending scale. (The lowest truth value in the Area of Interest was -0.555)

Results



Source data

Fenced Roads

Purpose

Tortoises are known to wander at least 10 to 15 km after translocation. Since major roads act as a source of mortality and are barriers to tortoises, translocating tortoise should be less favorable at distances less than this. However, if major roads are fenced you increase the amount of usable habitat and you can translocate tortoises closer to the road since the fence prevents road mortality

Source Data

***US Highways in California**, published January 2002, 1:100,000*
California Spatial Information Library, Sacramento, CA
http://gis.ca.gov

Abstract

This dataset is one from a series of transportation layers are derived from the US Census Bureau Tiger 2K (June 7, 2002 Version) information.

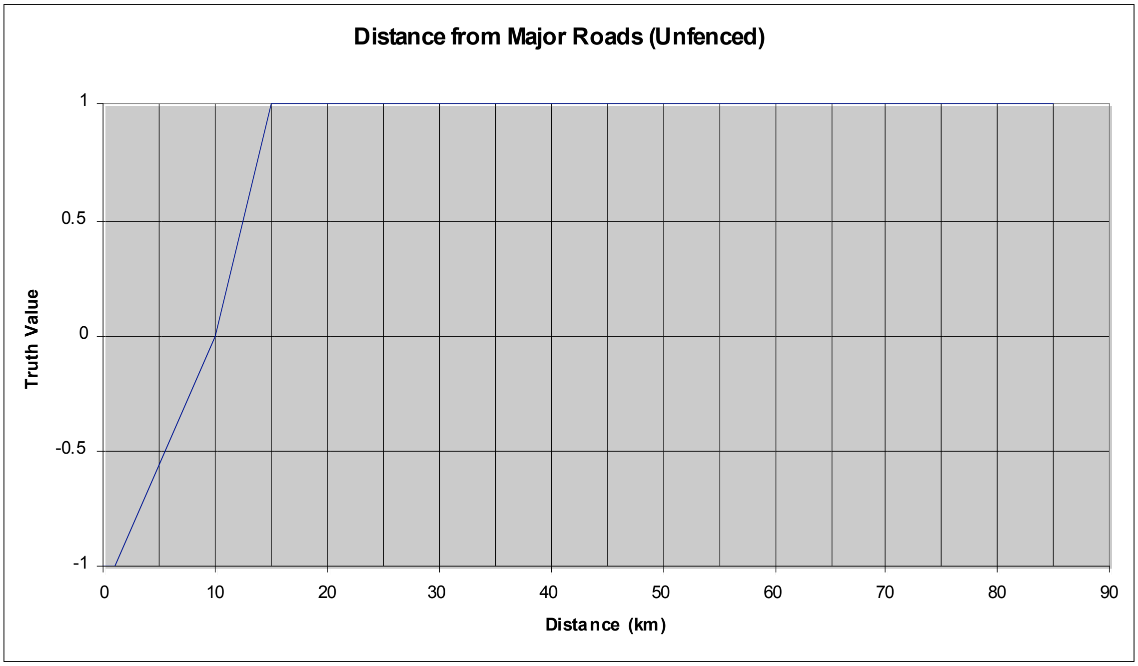
Processing Steps

Required major roads were extracted for analysis.

Parameters

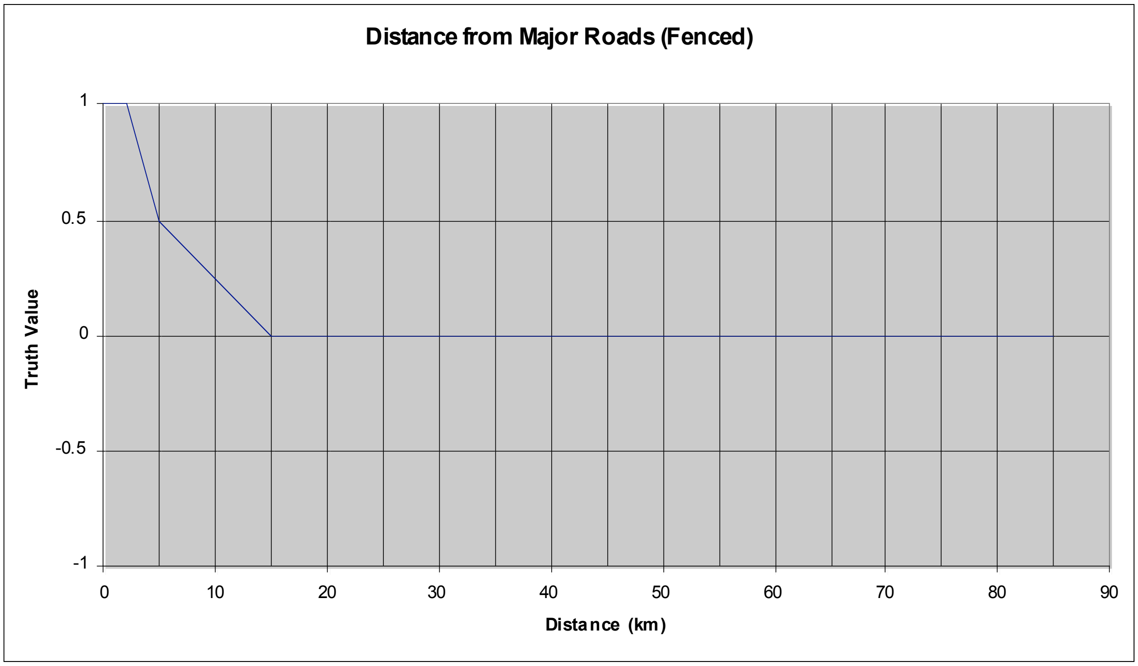
Scenarios were run for assumptions about existing and planned fencing. Two different sets of parameters were established for these scenarios

When a road was assumed unfenced, model truth values increased as the distance to the road increased.



- Sections within 10 kilometers of a major unfenced road were assigned truth values of -1 – 0 on an ascending scale
- Section between 10 and 15 kilometers from a major unfenced road were assigned truth values of 0 – +1 on an ascending scale
- Sections greater than 15 kilometers from a major unfenced road were assigned a truth value of +1

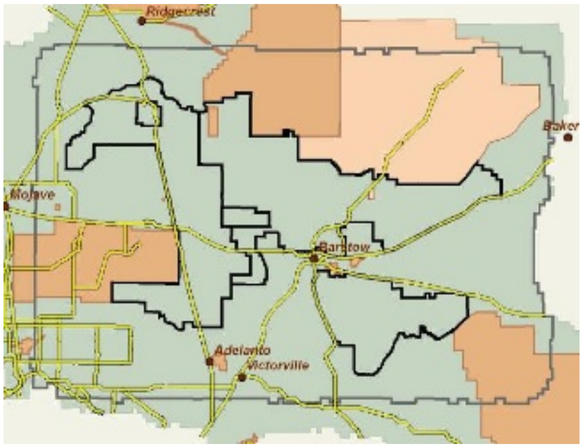
When a road was assumed fenced, model truth values decreased as the distance to the road increased



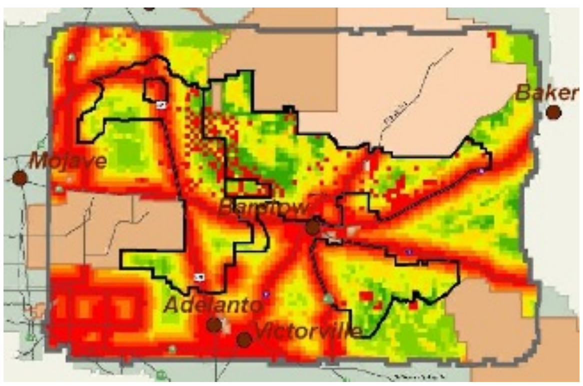
- Sections within 5 kilometers of a major fenced road were assigned truth values of +1 – +0.5 on a descending scale
- Sections between 5 and 10 kilometers from a major road were assigned truth values of +0.5 – 0 on a descending scale
- Sections greater than 10 kilometers from a major road were assigned a truth value of 0
-

Distance to Roads Parameters					
Distance	**1k**	**2k**	**5k**	**10k**	**15k**
Fenced	-1			0	1
Unfenced		1	1		0

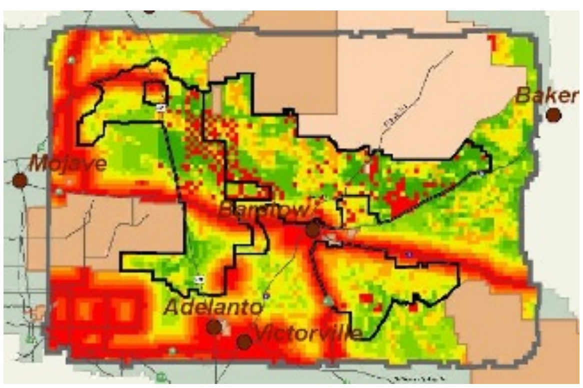
Source data



Model Results – No roads fenced



Model Results - Fort Irwin Road, Irwin Road, I-15, and US 395 fenced



Road Fragmentation

Purpose

The more sections of road per unit area (miles of road per square mile) the more fragmented the habitat and the worse this was for tortoises. Translocation was therefore less favorable to given areas as fragmentation increased (on a gradient scale).

Source Data

1. ***California Local Roads**, published January 2002, 1:100,000*
   California Spatial Information Library, Sacramento, CA
   http://gis.ca.gov

   Abstract
   This dataset is one from a series of transportation layers are derived from the US Census Bureau Tiger 2K (June 7, 2002 Version) information.
   Local, Neighborhood, and Rural Road A road in this category (A4) is used for local traffic and usually has a single lane of traffic in each direction. In an urban area, this is a neighborhood road and street that is not a thorough-fare belonging in categories A2 or A3. In a rural area, this is a short-distance road connecting the smallest towns; the road may or may not have a state or county route number.
2. ***Other Thoroughfares in California**, published January 2002, 1:100,000*
   California Spatial Information Library, Sacramento, CA
   http://gis.ca.gov

   Abstract
   This dataset is one from a series of transportation layers are derived from the US Census Bureau Tiger 2K (June 7, 2002 Version) information.
   Road with Special Characteristics This category (A6) includes roads, portions of a road, intersections of a road, or the ends of a road that are parts of the vehicular highway system and have separately identifiable characteristics.
   Road as Other Thoroughfare A road in this category (A7) is not part of the vehicular highway system. It is used by bicyclists or pedestrians, and is typically inaccessible to mainstream motor traffic except for private-owner and service vehicles. This category includes foot and hiking trails located on park and forest land, as well as stairs or walkways that follow a road right-of-way and have names similar to road names.
3. ***California State Highways**, published January 2002, 1:100,000*
   California Spatial Information Library, Sacramento, CA
   http://gis.ca.gov

Abstract
This dataset is one from a series of transportation layers are derived from the US Census Bureau Tiger 2K (June 7, 2002 Version) information. Secondary and Connecting Road This category (A3) includes mostly state highways, but may include some county highways that connect smaller towns, subdivisions, and neighborhoods.

4. ***US Highways in California**, published January 2002, 1:100,000*
California Spatial Information Library, Sacramento, CA
http://gis.ca.gov

Abstract

This dataset is one from a series of transportation layers are derived from the US Census Bureau Tiger 2K (June 7, 2002 Version) information.
Primary Highway with Limited Access Interstate highways and some toll highways are in this category (A1) and are distinguished by the presence of interchanges.
Primary Road Without Limited Access This category (A2) includes nationally and regionally important highways that do not have limited access as required by category A1. It consists mainly of US highways, but may include some state highways and county highways that connect cities and larger towns.

5. ***Vehicular Trails in California**, published January 2002, 1:100,000*
California Spatial Information Library, Sacramento, CA
http://gis.ca.gov

Abstract

This dataset is one from a series of transportation layers are derived from the US Census Bureau Tiger 2K (June 7, 2002 Version) information. Vehicular Trail A road in this category (A5) is usable only by four-wheel drive vehicles, is usually a one-lane dirt trail, and is found almost exclusively in very rural areas.

6. ***2001 BLM Route Designations**, 2001, 1:100,000*
Preliminary 2001 routes coverage acquired from Nanette Pratini, Staff Research Associate, UCR and GIS Database Manager, West Mojave and NECO PlansU.S. Bureau of Land Management
http://www.ca.blm.gov/cdd/directory.html

Abstract
This dataset contains routes which cross BLM designated land within the WEMO (West Mojave) management area. This dataset was developed to support the West Mojave Plan as "an attempt at defining a regional strategy for conserving plant and animal species and their habitats and to define an efficient, equitable, and cost-effective process for complying with threatened and endangered species laws."

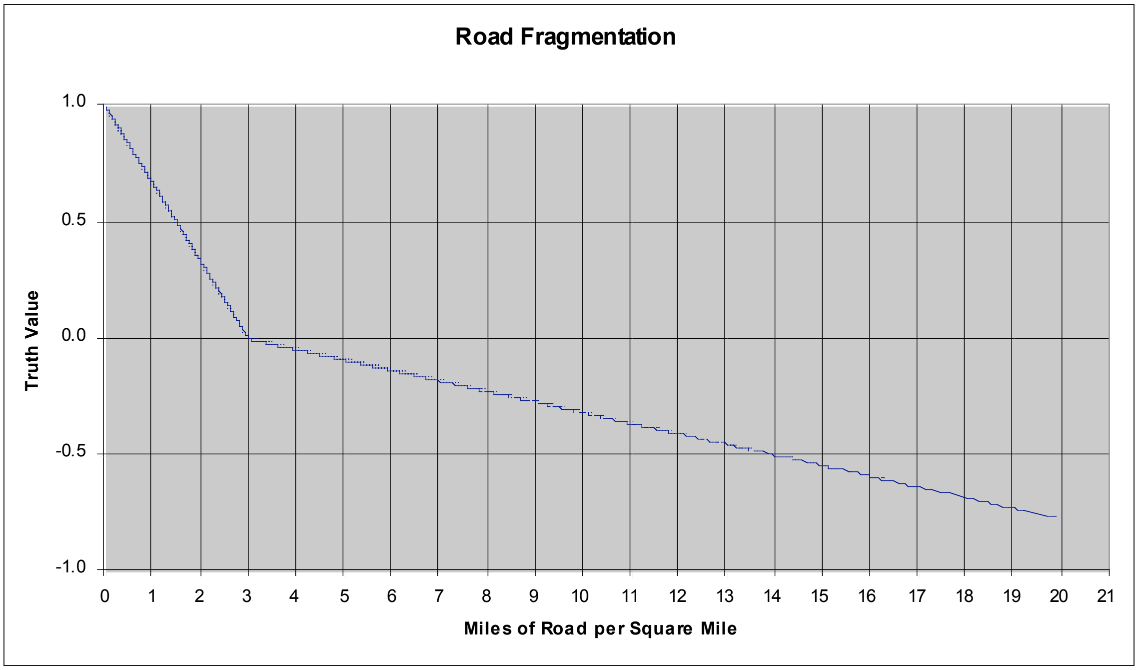
Processing Steps

Due to the varying extent and scale of available road data (see source data descriptions above), it was necessary to append the datasets together into a new master roads dataset. This was done using a geoprocessing model to:

1. Append all datasets together using APPEND
2. Use INTEGRATE with a cluster tolerance of 50 meters to make digitizing discrepancies coincident.
3. Road fragmentation for this model was defined as the length of road per unit area. This was accomplished using a geoprocessing model. The process steps are as follows:
4. Use INTERSECT to split all road segments at the section boundaries. This will also assign section MTRS values to the appropriate road segments
5. DISSOLVE segments on the MTRS value
6. Calculate the length of dissolved road segments
7. JOIN to PLSS feature class using MTRS as the join item to establish polygon geometry
8. Calculate fragmentation values (length / area)
9. Convert meter length values to miles. (Miles were used for this criteria because sections are approximately one square mile)
10. The results were then joined to a master criteria shapefile using the MTRS as the join item.

Parameters

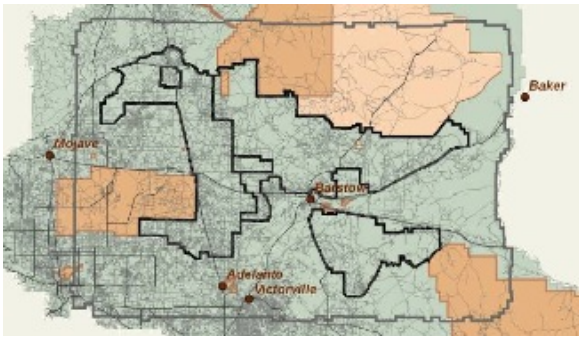
Model truth values decrease as the road fragmentation value increase.



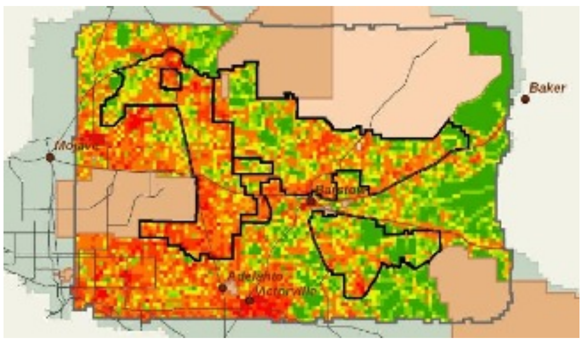
- Sections with less than 3 miles of road per square mile were assigned truth values from +1 – 0 on a descending scale
- Section with more than 3 miles of road per square mile were assigned truth values of 0 - -1 on a descending scale

Fragmentation Evaluation Parameters	
Miles per square mile	**Score**
25	-1
3	0
0	1

Source Data



Model Results



Die-Off Regions

Purpose

Translocating tortoises inside a die-off area can be good or neutral depending on the objective (i.e. suitability increases or decreases with die-off). Die-off region is good from the standpoint of repopulating an area that once had tortoises.

Source Data

1. ***Desert Tortoise Total Corrected Sign (TCS), 1998, 1999, 2001****;*
   1:100,000,
   coverage acquired from Nanette Pratini, Staff Research Associate, UCR and GIS Database Manager, West Mojave and NECO PlansU.S. Bureau of Land Management
   http://www.ca.blm.gov/cdd/directory.html

Abstract
This coverage contains desert tortoise transect information for the West Mojave regional planning area collected during 1998, 1999, and 2001 field survey efforts. Total Corrected Sign (TCS) is a derived value based on calculations involving observed desert tortoise sign. In 2001, Ed Larue and a team of biologist conducted field transects using BLM methodology looking for desert tortoise sign. From hard copy field notes, BLM

employee Emily Cohen entered the values into an EXCEL spreadsheet and gave each transect unique site #. Using the easting/northing coordinate data transect locations were entered into an Arc/Info coverage by Ric Williams. The site# attribute was the unique value used in database creation for attachment of observational data to point features.

2. ***Live and Carcass Observations of the Desert Tortoise in the Mojave Desert (LDS), 2001, 2002, 2003, 2004****; 1:100,000*
   U.S. Fish & Wildlife Service
   http://pacific.fws.gov/index.html

Abstract
As a result of directives outlined in the 1994 Desert Tortoise (Mojave Population) Recovery Plan and decisions ultimately made by the Desert Tortoise Management Oversight Group, line distance sampling was chosen as the method for determining range wide population status. This multi-year coordinated effort was undertaken in 2001, under the direction the USFWS Desert Tortoise Recovery Coordinator, Mr. Phil Medica. Line distance sampling was chosen as the method for determining range wide population status and is to be continued consistently over the next several decades until adequate baseline data are established to determine population status (i.e. increasing, decreasing, stabilizing). For the sampling year 2002, field crews were outfitted with electronic data collection equipment instead of the pencil and paper data sheets used in the previous year. By entering data directly into an electronic format, transcription errors are eliminated and data standards are enforced. Data is then transferred to a relational database, and is maintained by the Mojave Desert Ecosystem Program (MDEP), which also provides logistical sampling, and data storage support. Distance sampling software is used to estimate tortoise densities on an individual Desert Wildlife Management Area (DWMA) basis. This analysis is being conducted by Dr. Steve Corn, of the USGS, in cooperation with Mr. Medica. In addition, spatial analyses are being conducted by the Redlands Institute, Desert Tortoise Project, under the direction of Dr. Jill S. Heaton.

Processing Steps

It was decided that all sections would be categorized into “Live”, “Dead”, “No Observation”, and “Unsampled” based on both TCS and LDS data.
TCS points and LDS corner and observation points were used to categorize sections using the following criteria:

1. All sections with any scat or live observations for all available years were categorized as “Live” sections

2. All sections with only dead or carcass observations and no “Live” criteria for all available years were categorized as “Dead” sections

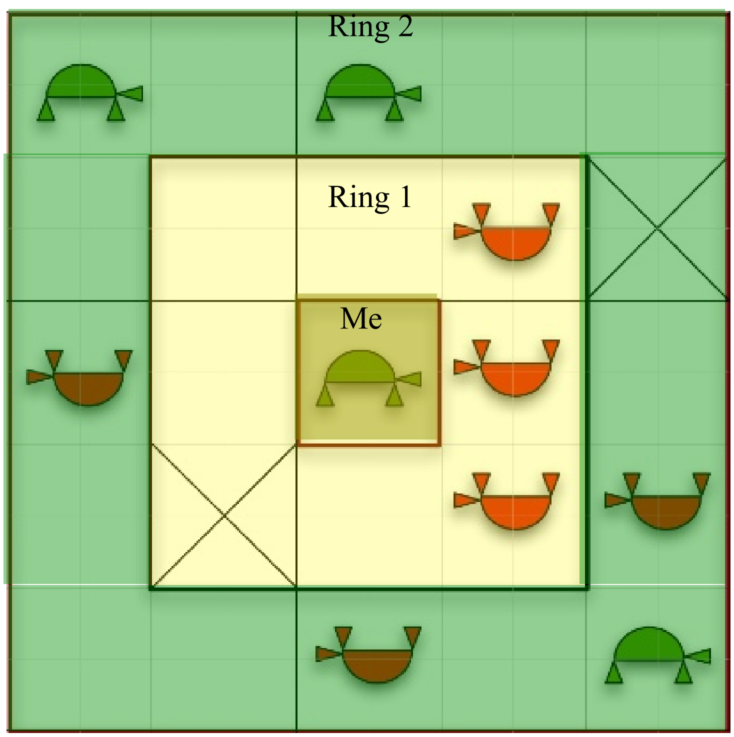
3. All sections that were sampled but no observations were made for all available years was categorized as “No Observation” sections

4. All unsampled sections for all available years were categorized as "Unsampled"

A neighbor analysis methodology and custom geoprocessing tool was developed to determine the "Die-Off" value of a section.
Each section will evaluate its neighboring 24 sections or two "rings" (see figure) by counting the number of "Dead" surrounding sections.
The overall score will be normalized by the ring it is found in, the number of sampled sections, and the number of available sections using the formula below:

$$DieScore = M * (W / X) + (N * 0.5) * (Y / Z)$$

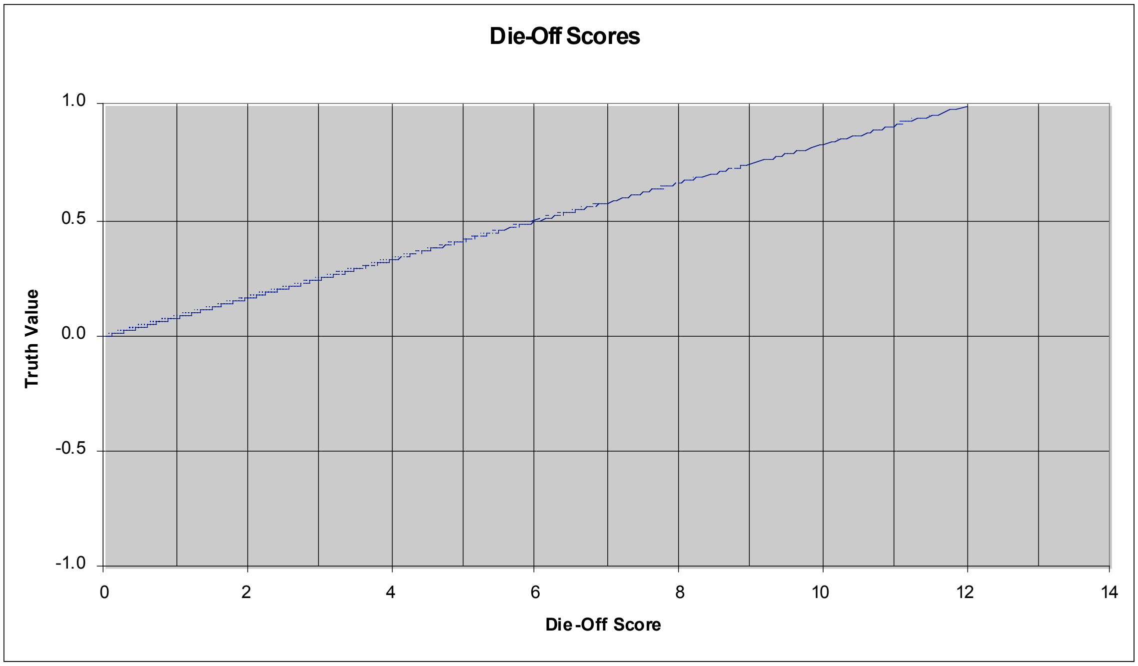
Where:
M = Count of Carcass Sections in Eval Section and Ring 1
W = Count of Sampled Sections in Eval Section and Ring 1
X = Total Count of Sections in Eval Section and Ring 1
N = Count of Carcass Sections in Ring 2
Y = Count of Sampled Sections in Ring 2
Z = Total Count of Sections in Ring 2



The score for the figure above would evaluate as 4.073:
4.073 = [(0 + 3) * (8 / 9)] + [(3 * 0.5) * (15 / 16)]

Parameters

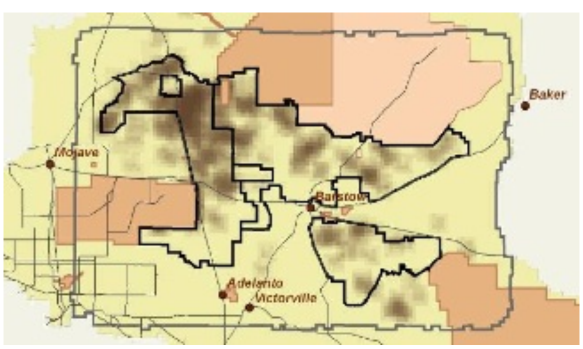
Model truth values increase as die-off score values increase.



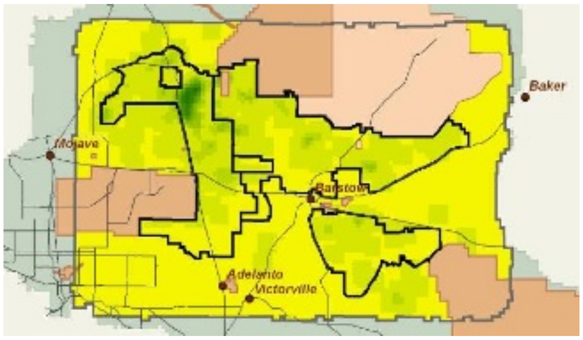
Sections were assigned truth values directly proportional to their Die-Off Score on a scale of 0 - +1.

Die-Off Score Parameters	
Die Score	Score
0	0
12	1

Source Data



Model Results



Ownership

Purpose

Private multiple land ownership is less favorable for obtaining permission to translocate tortoises or less favorable for purchasing land because of logistics.

Source Data

1. ***California Surface Land Ownership****, published January 1998, updated Oct. 2004, 1:100,000*
   U.S. Bureau of Land Management
   http://www.ca.blm.gov/gis/

   Abstract
   The ownpax data of the surface ownership layer is intended to illustrate state wide and regional land ownership. Large land holders are emphasized in detail and they are Federal, State, and local governments. Private land owners are, for the most part, simply carried as private, generalizing this group as one. This data set is based on BLM 1:100,000 surface management quads. FRRAP of the CA Department of Forestry digitized the data from the base maps. The Teale Data Center maintained the data after that, until the BLM purchased a version in 1991. Since that time, BLM has made significant modifications to the data set for its own internal requirements.
2. ***Section Level Ownership for Areas South of Fort Irwin,*** *unpublished 2004, 1:100,000 University of Redlands, Redlands Institute*

   Abstract
   The section level ownership feature class was developed to determine the number of private and government owners per section and private and government parcels per section. Available parcel level ownership tables were acquired from the US Army Corps of Engineers. This data was categorized into private and government parcels through assumptions based on owner names and addresses. Counts of owners and parcels per

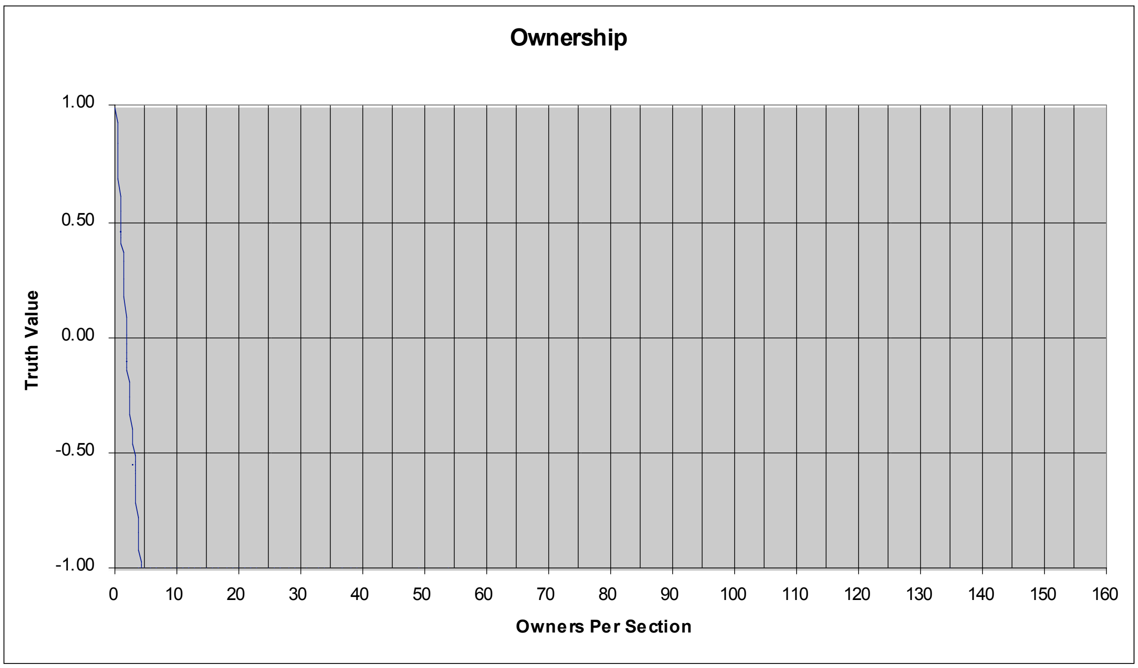
section by category were done using a pivot table and joined to the PLSS Section feature class to establish polygon geometry.

Processing Steps

Because parcel level ownership was not available for the extent of the study area, the California Surface Land Ownership was used for areas where parcel level ownership was not available. This data was generalized to the section level by using UNION to find the percent cover of ownership categories. All sections containing privately-owned land were given a categorical value of 1 for later analysis.

Parameters

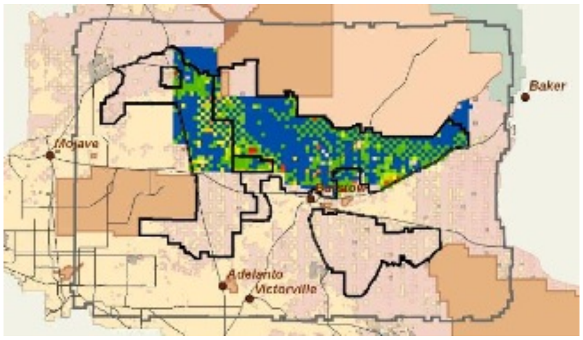
Model truth values increase as owners per section values increase.



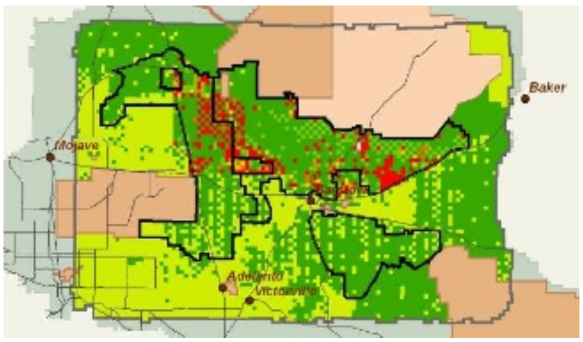
- Sections with less than 3 owners per section were assigned truth values from +1 – -1 on a sharply descending scale.

Ownership Parameters	Evaluation
# of Private Owners	Score
4	-1
2	-0.1
0	1
Unknown	0

Source Data



Model Results



Projected Growth

Purpose

As with urban areas, tortoise habitat will be degraded and human disturbance will be high within or close to projected growth areas. Therefore translocating tortoises away from projected growth areas is more favorable.

Source Data

***Projected Urban Growth**, published Sept. 2002, 1:100,000*
California Department of Forestry and Fire
http://frap.cdf.ca.gov/data/frapgisdata/select.asp

Abstract

Projections of development are proportional allocations of California Department of Finance (DOF)countywide population projections, converted to housing units using the county's overall ratio of houses to people in 2000. To facilitate allocations transform census block groups into decadal housing counts for square zones approximately 2500 hectares (9.6 square miles) in area. A zone's share of county housing growth in the 1990-2000 period determines its allocation. At this spatial grain, proportional historical growth in a given decade explains much of the overall growth variation in the subsequent decade. Historical data come from housing counts in the 2000 U.S. Census of Population and Housing long form survey question "Year Structure Built" (Summary Tape File 3A). Note that if a house was demolished and rebuilt, only the rebuild date is reflected in the data, which means that housing density in earlier decades may be underestimated. For a detailed methodology of CDF-FRAP's projection model see http://frap.cdf.ca.gov/projects/development_vegetation/index.html.

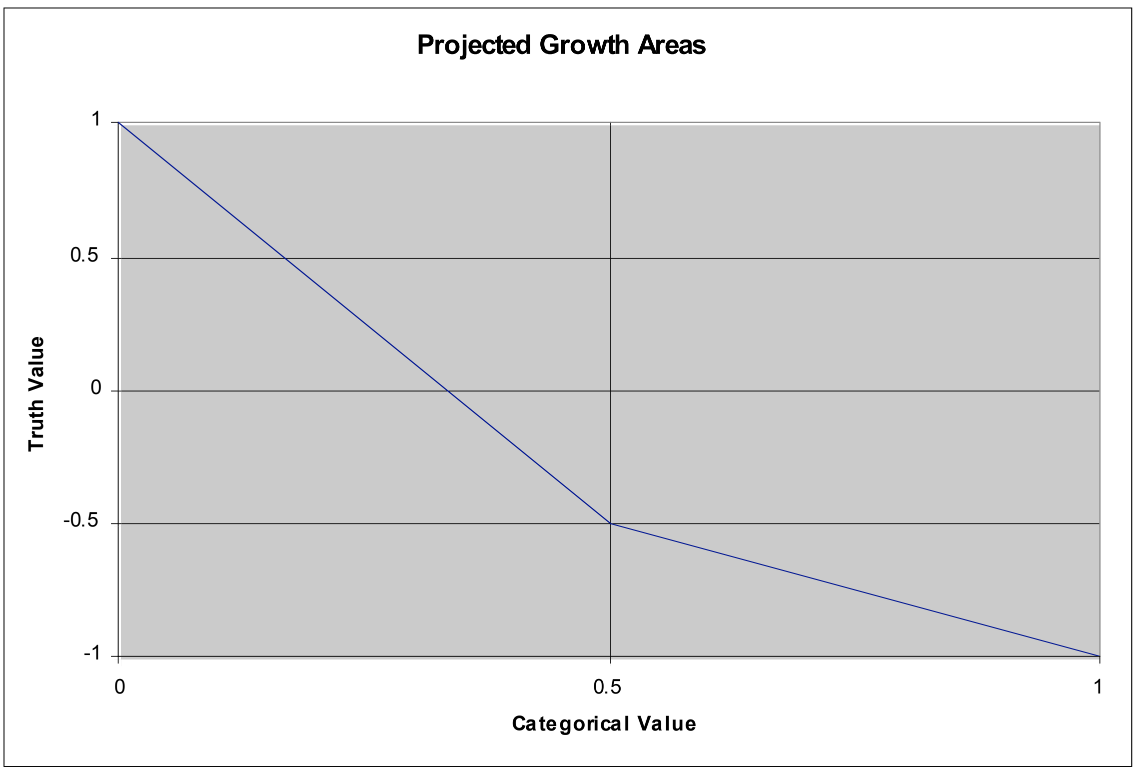
Processing Steps

An inclusion analysis was done to determine sections completely within, intersecting (touching), or completely outside an area of projected urban growth. A custom geoprocessing model was developed to identify these sections and assign the following categorical values.

- 1 = completely within
- .5 = intersecting
- 0 = completely outside

Parameters

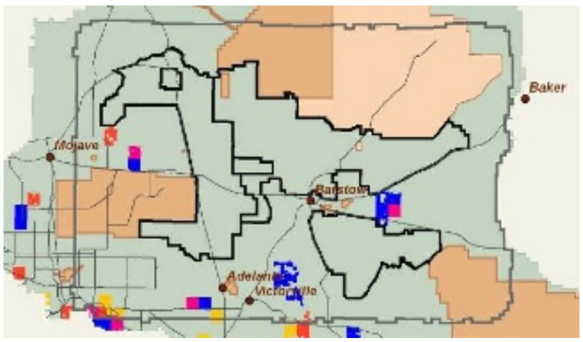
All sections that were either completely within (1) or were intersecting (0.5) an area of projected growth were assigned truth values of -1.



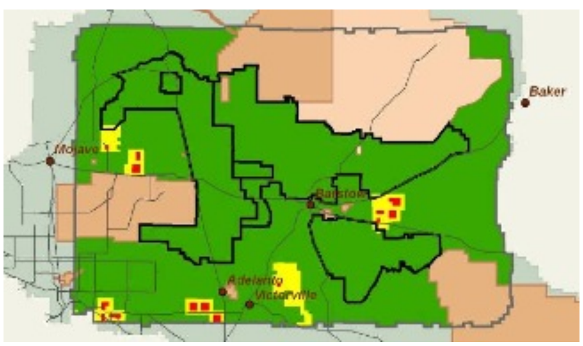
- All sections that were completely outside (0) of areas of projected growth were assigned truth values of +1.

Projected Growth Parameters	
Section Location	Score
Within (1)	-1
Intersect (0.5)	-0.5
Outside (0)	+1

Source Data



Model Results



OHV Areas

Purpose

OHV can be detrimental to tortoises by either degrading tortoise habitat or by inadvertently crushing tortoises and burrows. OHV areas (areas designated for high off road use) were excluded as translocation sites.

Source Data

Federal Off Highway Vehicle Areas, CA; *published July 1999, 1:100,000*
U.S. Bureau of Land Management
http://www.ca.blm.gov/gis/

Abstract

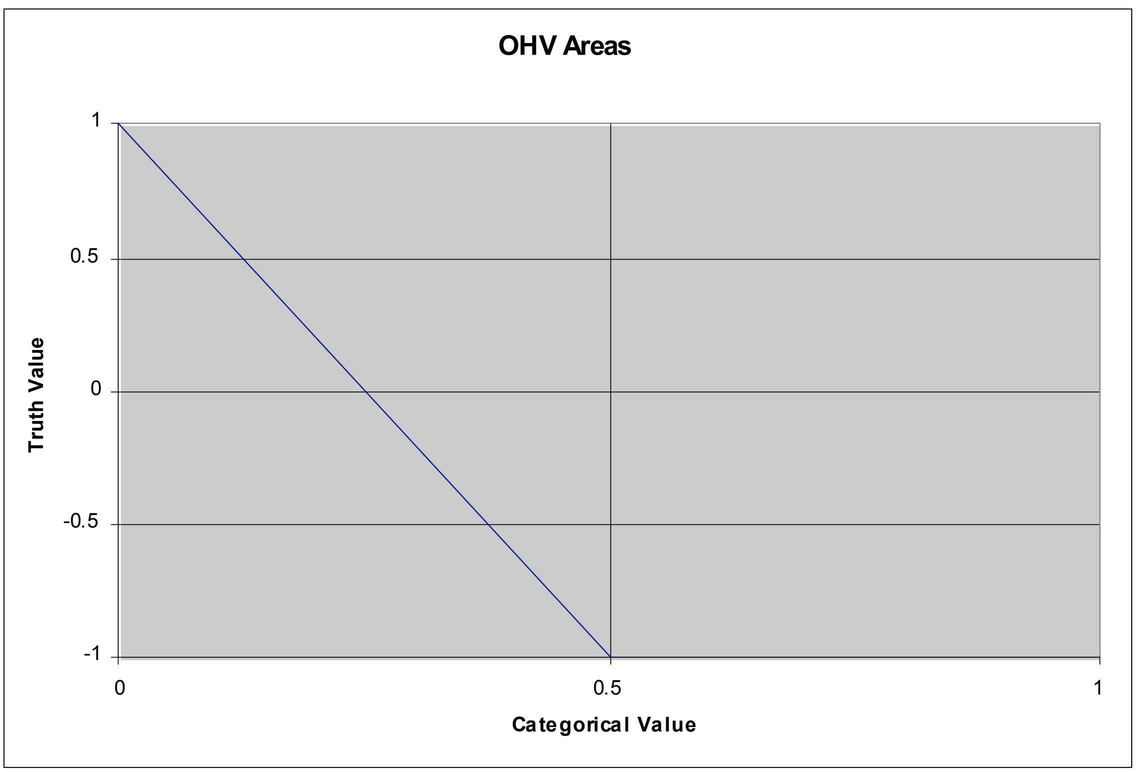
These data have been developed to allow the illustration of Federal OHV areas in California, and for use in inventorying features within OHV areas in California.

Processing Steps

An inclusion analysis was done to determine sections completely within, intersecting (touching), or completely outside an open non-military OHV Area. A custom geoprocessing model was developed to identify these sections and assign the following categorical values.

- 1 = completely within
- .5 = intersecting
- 0 = completely outside

Parameters

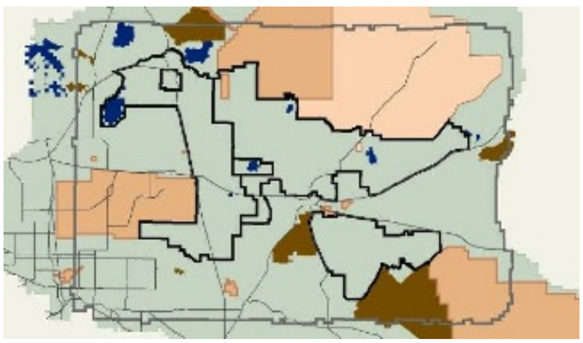


- All sections that were either completely within (1) an open non-military OHV area were assigned truth values of -1.

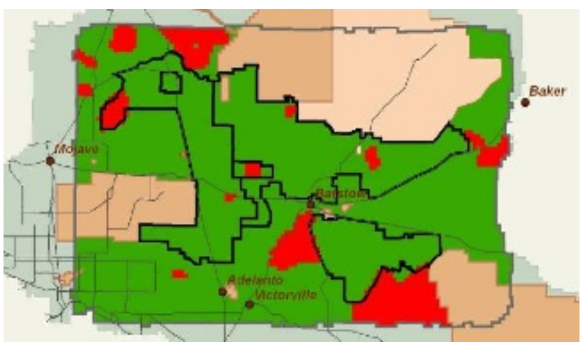
- All sections that were intersecting (0.5) an open non-military OHV area were assigned truth values of -.05.
- All sections that were completely outside (0) of an open non-military OHV area were assigned truth values of +1.

OHV Evaluation Criteria	
Section Location	Score
Within	-1
Intersect	-0.5
Outside	1

Source Data



Model Results



Geomorphology

Purpose

Certain geomorphologic features (e.g. reservoirs, playas, & volcanic highlands) represent unsuitable habitat for tortoises and were excluded as translocation sites

Source Data

1. ***Streams within the Mojave Desert Ecosystem****; published May 1998, 1:100,000 U. S. Geological Survey (download from MDEP)*

Abstract
These data were prepared from the 1:100,000-scale materials associated with the USGS Topographic Map Series. They have been modified from the original USGS digital line graphs by Utah State University.

2. ***GLASC****; published April 2000, 1:100,000*
US Army Topographic Engineering Center & Louisiana State University, Baton Rouge, LA (download from MDEP)

Abstract
The Louisiana State University and the US Army Topographic Engineering Center are mapping the earth materials and landforms of the California portion of the Mojave Desert using a combination of spaceborne spectral scanners, air photo interpretation, and geological field techniques. This effort is not a compilation of previous work but is instead an attempt to create a regionally uniform Geographic Information System (GIS) data layer whose accuracy and precision is known and verified; the digital form of the GIS layer also allows for rapid changes in the product as new information is obtained. The mapped area covers ~150,000 km2. The mapping base passes 24,000; the GIS layer contains ~30,000 polygons, with MMU of 10 hectares. The final products will include a digital GIS layer, 100,000, and a website that describes the methodology used in mapping, definitions of mapping units, and practical implications of the data.

Processing Steps

The GLASC was reclassified to better meet the needs of the Desert Tortoise Habitat Model. The GLASC feature class was reclassified under the direction of Dr. Jill Heaton as follows:

Landform	Landform Reclass
Active Alluvial Plain	Alluvial Plain
Alluvial Fan	Alluvial Fan
Bajada	Bajada
Barchanoid Dune Field	Dune
Bedrock Plain	Bedrock Plain
Canyon Bottomland	Canyon Bottomland
Climbing/Falling Dune Field	Dune
Coppice Dune Field	Dune
Erosional Highland	Erosional Highland
Fluvial Channel	Fluvial Channel
Fluvial Floodplain	Fulvial Floodplain
Fluvial Terrace	Fluvial Terrace
Inselberg	Inselberg
Intramontane Alluvial Plain	Intramontane Alluvial Plain
Intramontane Undifferentiated	Intramontane Undifferentiated
Lacustrine Terrace	Lacustrine Terrace
Lava Field	Lava Field
Linear Dune Field	Dune
Older Alluvial Deposit	Older Alluvial Deposit
Older Alluvial Plain	Older Alluvial Plain
Parabolic Dune Field	Dune
Playa	Playa
Reservoir	Reservoir
Sand Sheet	Sand Sheet
Undifferentiated Dune Field	Dune
Undifferentiated Sediment	Undifferentiated Sediment
Unmapped	Unmapped
Volcanic Dome	Volcanic Highlands
Volcanic Tableland	Volcanic Highlands
Volcano	Volcanic Highlands
Wash	Wash

Because GLASC does not accurately take into account streams, a reclassification of the GLASC feature class was done for Desert Tortoise habitat modeling. The GLASC feature class was reclassified under the direction of Dr. Jill Heaton as follows:

- All geomorphology types designated by GLASC as the following that intersect a stream (see source data description) should be reclassified as “Canyon Bottomland” within a 100 meter buffer of the stream:

- “Erosional Highland”, “Volcano”, “Volcanic Dome”, “Volcanic Tableland”, “Intramontane Alluvial Plain”, “Intramontane Undifferentiated”, “Canyon Bottomland”, and “Inselberg”.

- All other landforms (not listed above) that intersect streams minus unmapped and reservoir were reclassified as “Wash” within a 100 meter buffer of the stream.

Geoprocessing models and scripts were developed to generalize the reclassified GLASC data to the section level. The resulting feature class contained data about the dominant 5 landforms within the section and their percent of cover. The model processing steps were as follows:

1. UNION the reclassified GLASC feature class to the PLSS Section feature class

2. Add fields for each landform type and populate with the types percent cover. (Landform area / Section area)

3. DISSOLVE feature class based on MTRS value maintaining the total of the landform percent cover values.

4. Loop through each landform percent cover field to determine dominant landform type and write the type value to a new LF1_Type and the percent cover value to a new LF1_PercCov field. Calculate the original landform type field to 0. Loop through 4 more times. (Calculating the field to 0 ensures that the next loop will not evaluate this type as the dominant type, but will find the next most dominant for each iteration.)

5. The results were then joined to a master criteria shapefile using the MTRS as the join item.

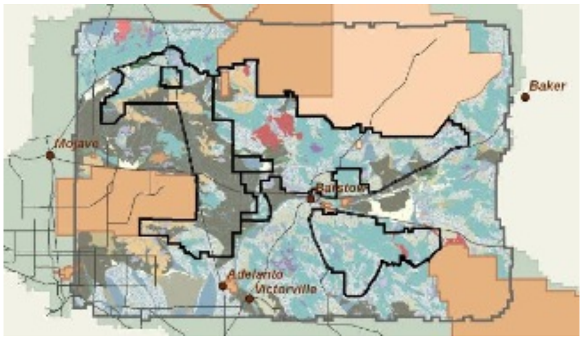
Parameters

Geomorphology was used as the source data for a number of criteria within the habitat potential model. These parameters may be found in the habitat potential model technical documentation.

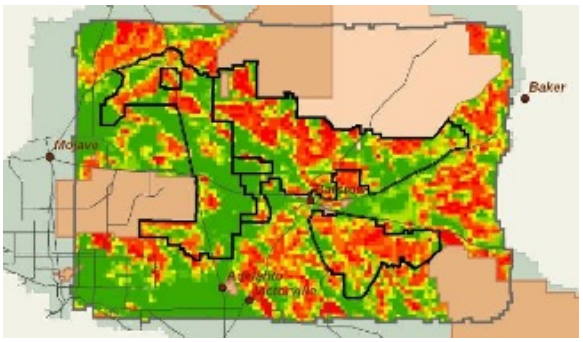
Geomorphology was used evaluated using the following criteria:

Landform	Truth Value
Alluvial Deposit	-0.5
Alluvial Fan	1
Alluvial Plain	1
Bajada	1
Bedrock Plain	-0.5
Canyon Bottomland	1
Dune	-1
Erosional Highland	-0.5
Fluvial Channel	-0.5
Fulvial Floodplain	1
Inselberg	-0.5
Intramontane Alluvial Plain	1
Intramontane Undifferentiated	0
Lacustrine Terrace	0.5
Lava Field	-0.05
Playa	-1
Reservoir	-1
Sand Sheet	0.5
Undifferentiated Sediment	0.5
Volcanic Highlands	-1
Wash	1

Source Data



Model Result



Elevation/Latitude

Purpose

Based on discussions with desert tortoise biologists, tortoises are not commonly found at elevations above 1524 m at lower latitudes or above 1219 m at higher latitudes. Therefore these elevations were excluded as translocation sites

Source Data

30 meter DEM*; published July 1998*
United States Geological Survey

Abstract

This database consists of data from a mosaic of individual 1:24,000 1-arc second Digital Terrain Elevation Data tiles for the Mojave Desert Ecoregion, that have been resampled to 120 meters. The 7.5-minute digital elevation model (DEM) data are digital representations of cartographic information in a raster form. The DEMs consist of an array of elevations for ground positions at regularly spaced intervals. The data are produced in 7.5- by 7.5-minute blocks either from digitized cartographic map contour overlays of from scanned National Aerial
Photography Program (NAPP) photographs. Individual USGS format 1:24,000 tiles were downloaded from the Eros Data Center web site. All tiles were imported to Arc/INFO grid format with a geographic projection in decimal seconds, datum - NAD83. Tiles were joined together using the Arc DEMLATTICE command. The resulting grid was projected to UTM, Zone 11, NAD83 to conform with the Mojave Desert Ecosystem Initiative data standards. A boundary file was used to clip the study area out of the mosaic to form the present dataset. Following the creation of this mosaic, these data were resampled to 120 meters to allow the dataset to fit on 1 CD-ROM.

Processing Steps

Elevation
A geoprocessing model was developed to generalize elevation data (see source data description above) to the PLSS Section level using an Area Weighted Average method. The processing steps were as follows:

1. RESAMPLE data to 1000 meters
2. Convert raster DEM to vector
3. UNION vector DEM to PLSS feature class
4. Calculate <elevation> * <percent cover of section> to preliminary value field
5. DISSOLVE feature class maintaining SUM of preliminary value field
6. The results were then joined to a master criteria shapefile using the MTRS as the join item.

Latitude
Latitude was assigned to each section based on latitude of the midpoint of the section.

Parameters

Elevation and latitude are modeled together on a dynamic fuzzy curve. The anchor points on a dynamic fuzzy curve change depending on the values on another complementary curve. In this model, the anchor points on the elevation fuzzy curve are dependent on the latitude fuzzy curve. The lower the latitude, the higher the acceptable elevation ranges.

Description	Latitude Anchor Point (in decimal degrees)	Elevation Anchor Point (in meters)	*NetWeaver Value*
Moderate elevation at low latitude	33.259	-82.295	0
Good elevation at low latitude	33.259	356.76 - 1524	1
False elevation at low latitude	33.259	1584.96	-1
Moderate elevation at high latitude	37.274	-82.296	0
Good elevation at high latitude	37.274	243.84 -1219.2	1
False elevation at high latitude	*37.274*	*1280.16*	-1

Precipitation

Purpose
The precipitation model is based on knowledge from domain experts and literature that suggest an increase in tortoise activity after high rainfall and an increase in tortoise mortality after periods of low rainfall and / or drought (Corn 1994; Duda et al 1999;

Longhsore et al 2002). The goal of the precipitation topic is to obtain a measure of rainfall effectiveness in support of tortoise habitat. The following three components of precipitation were identified as important for the desert tortoise: 1) amount of rainfall in a given season, 2) variability in the amount of that rainfall, and 3) the drought pattern. These parameters are based upon knowledge and data that support that a minimum amount of precipitation is required to support tortoise habitat, that smaller amounts of rain spread out over the season are better than one large rain event, and that multiple years of drought are unacceptable for supporting the survival of tortoises (Peterson 1994).

Amount and Variability

Amount and variability are co-dependent variables. In the context of desert tortoise habitat, the optimal amount of precipitation is dependent on the variability of rainfall in that area ((J. Heaton et al, *Personal Communication* 2003)**)**. For example, an area with low precipitation and low variability is considered least acceptable due to the high probability of consistently low precipitation. Conversely, an area with low precipitation but high variability is slightly better due the greater probability of not having consistently low precipitation.

The model also accounts for seasonal differences in precipitation and its effect on the desert tortoise. There are two Amount and Variability Models, one for summer and one for winter. The winter season includes the months of October, November, December, January, February, and March. The summer season includes the months of April, May, June, July, August, and September.

The models are identical in structure but contain different parameters for defining the optimum amount of precipitation amount and variability. Because of increased winter activity (add reference), desert tortoise winter precipitation requirements are higher than those of summer (Duda 1999)**.**

Drought

Consecutive drought years are considered to have a negative impact on desert tortoise activity (Berry 2002)**.** The drought model measures the mean number of consecutive drought years occurring over a 100 year period. For desert tortoise habitat potential, a drought year is a year where total precipitation is below 38.1mm (1.5 inches) (J. Heaton et al, [*Personal Communication*] 2003).

Source Data

PRISM Climate Model*, published 2002,*
Spatial Climate Analysis Service, Oregon State University
http://www.ocs.oregonstate.edu/prism.

Abstract

Spatially distributed monthly and annual precipitation. Each file represents 1 month of 1 year for the period 1895-1997. Distribution of the point measurements to a spatial grid was accomplished using the PRISM model, developed by Christopher Daly, Director, Spatial Climate Analysis Service, Oregon State University. Care should be taken in estimating precipitation values at any single point on the map. Precipitation estimated for each grid cell is an average over the entire area of that cell; thus, point precipitation can be estimated at a spatial precision no better than half the resolution of a cell. For example, the precipitation data were distributed at a resolution of approximately 4km. Therefore, point precipitation can be estimated at a spatial precision no better than 2km. However, the overall distribution of precipitation features is thought to be accurate. For further information, the online PRISM homepage can be found at http://www.ocs.oregonstate.edu/prism.

Processing Steps

Amount

1. use cell statistics to sum the rasters for the winter months for each year
2. use cell statistics to average the winter over all years
3. project the raster to match the study shapefile's projection
4. use zonal statistics as table to aggregate to sections
5. drop items other than MTRS and MEAN

Variability

1. use cell statistics to sum monthly average number of wet days for winter months
2. use zonal statistics as table to aggregate to sections
3. drop items other than MTRS and MAJORITY

Drought

1. Sum the winter months for each year
2. Flag cells with precipitation lower than threshold for each year using Test
3. Times each consecutive pair of years to find areas with continuous drought
4. Sum the pairs to find the number of consecutive years
5. project the raster to match the study shapefile's projection
6. use zonal statistics as table to aggregate to sections
7. drop items other than MTRS and MEAN

Parameters

There are two Amount and Variability Models, one for summer months and one for winter months. The summer and winter models are joined together with the "UNION" operator. The results of the summer and winter union are joined together with the drought model. Figure 1 shows the relationships between the summer amount/variability, winter amount/variability, and drought.

1. Amount and Variability

Amount and variability are modeled together using a dynamic fuzzy curve. The anchor points on a dynamic fuzzy curve change depending on the values on another complementary curve. In this model, the anchor points on the amount fuzzy curve are dependent on the variability of precipitation in that area. In other words, the optimal amount of precipitation is dependent on the variability.

Amount is measured using mean seasonal precipitation. Variability is measured as the mean number of seasonal wet days. A wet day is a day when rainfall is recorded. Refer to the spatial data model section below for more information on how this data was calculated.

Fuzzy Curve Anchor Points, NetWeaver Values, and Descriptions

The following tables show the anchor points and values for the amount fuzzy curve, the variability fuzzy curve, and how amount and variability are calculated together in a dynamic fuzzy curve.

Mean Seasonal Precipitation Anchor Points and NetWeaver Values

Season	Amount (mean seasonal precipitation in mm)	Value	Description
Winter	19	-1	poor (low rainfall)
	30	.5	moderate (medium rainfall)
	70	1	good (high rainfall)
Summer	9	-1	poor (low rainfall)
	30	.5	moderate (medium rainfall)
	40	1	good (high rainfall)

Variability Anchor Points and NetWeaver Values

Season	Variability (# of wet days)	Value	Description
Winter	6	0	poor (high variability)
	46	1	good (low variability)
Summer	3	0	poor (high variability)
	14	1	good (low variability)

Descriptors and NetWeaver Values, Amount/Variability dynamic curve

Amount Description	Variability Description	*Value*
poor (low rainfall)	poor (high variability)	-1
poor (low rainfall)	good (low variability)	-.5
moderate (medium rainfall)	poor (high variability)	0
moderate (medium rainfall)	good (low variability)	.5
good (high rainfall)	poor (high variability)	.5
good (high rainfall)	good (low variability)	1

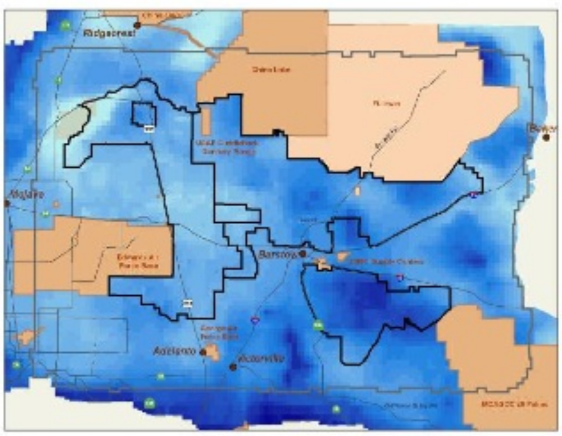
2. Drought

Drought is modeled on a fuzzy curve. Drought is measured in mean consecutive drought years. A consecutive drought year is two consecutive years where in each year the total precipitation is below 38.1mm (1.5 inches).

Drought Fuzzy Curve Values

Mean number of consecutive drought years	Description	Value
1	poor	-1
.5	moderate	0
0	good	1

Source Data



Critical Habitat Units

Purpose

Translocating tortoises inside the CHU can be good, bad, or neutral depending on the objective. CHU is good for translocation because it represents quality protected habitat. CHU is bad because translocated tortoise introduce disease or may be genetically dissimilar animals to a "good" population.

Source Data

***Critical Habitat Units**; published 2002, United States Fish and Wildlife Service, Mojave Desert Ecosystem Program (MDEP)*

Abstract

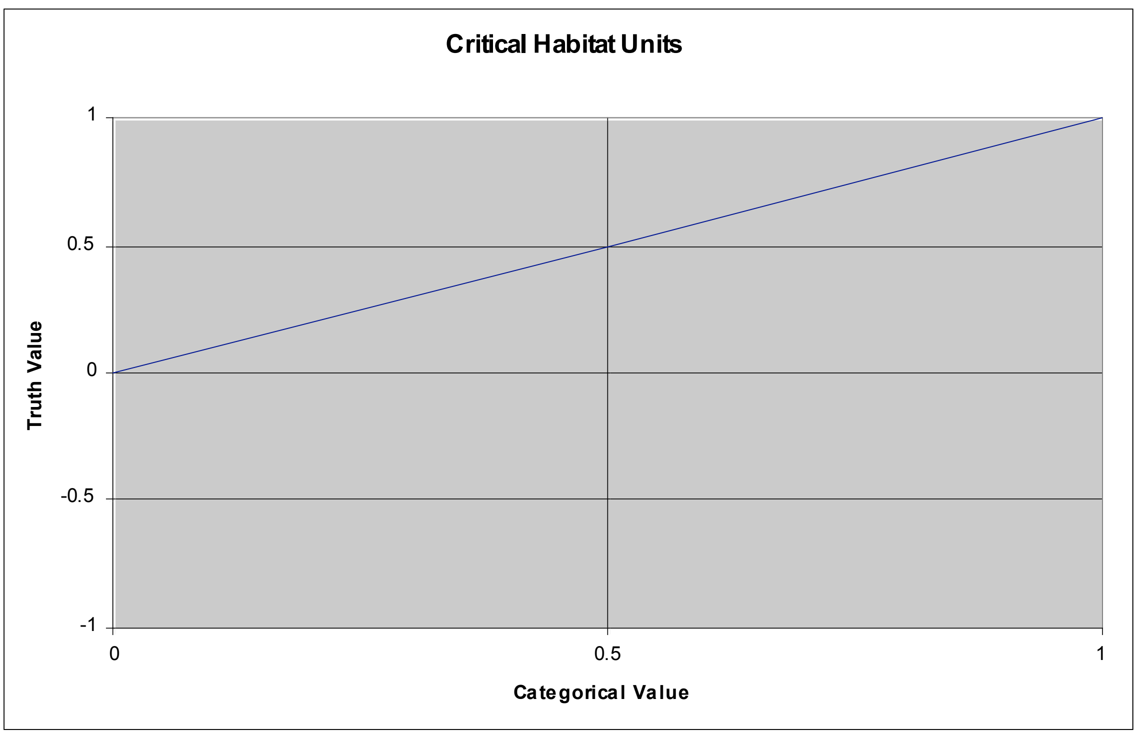
Critical habitat is a term defined and used in the Endangered Species Act. It is a specific geographic area(s) that is essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery. An area is designated as "critical habitat" after the U.S. Fish & Wildlife Service publishes a proposed Federal regulation in the Federal Register and then receives and considers public comments on the proposal. The final boundaries of the critical habitat area are also published in the Federal Register. Federal agencies are required to consult with the U.S. Fish & Wildlife Service on actions they carry out, fund, or authorize to ensure that their actions will not destroy or adversely modify critical habitat. In this way, a critical habitat designation protects areas that are necessary for the conservation of the species. A critical habitat designation has no effect on situations where a Federal agency is not involved - for example, a landowner undertaking a project on private land that involves no Federal funding or permit.

Processing Steps

An inclusion analysis was done to determine sections completely within, intersecting (touching), or completely outside a Critical Habitat Unit. A custom geoprocessing model was developed to identify these sections and assign the following categorical values.

- 1 = completely within
- .5 = intersecting
- 0 = completely outside

Parameters



- All sections that were completely within (1) a Critical Habitat Unit were assigned truth values of +1.
- All sections that were intersecting (0.5) a Critical Habitat Unit were assigned a truth value of +0.5

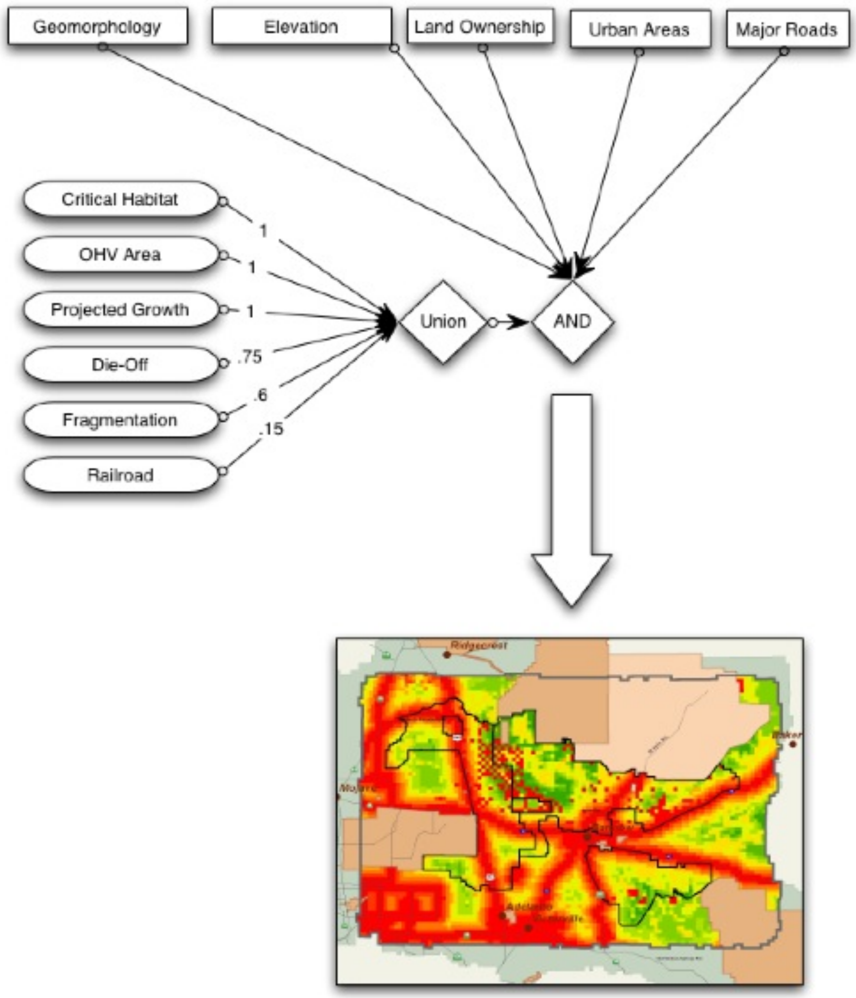
- All sections that were completely outside (0) of areas of projected growth were assigned truth values of 0.

CHU Evaluation Criteria	
Section Location	Score
Within (1)	1
Intersect (0.5)	0.5
Outside (0)	0

Model Weighting

The parameters in the decision support model were arranged in a logical structure which effectively ranked them according to how important they were considered to be in the decision process. This logical structure was developed by combining the expert opinion of many scientists, managers and stakeholders during workshops hosted by the Redlands Institute Desert Tortoise Project (J. Heaton, University of Nevada, Reno – *Personal Communication*) with guidance from the authors of this plan.

Parameters were assigned to one of two groups according to how important they were interpreted to be in the decision process (Figure 6). The most influential group consisted of the following parameters: geomorphology, elevation, land ownership, urban areas, and major roads. This group was weighted most heavily such that if any one of the parameters was unsuitable that section was considered unsuitable for translocation (i.e., the logical AND operator – Figure 6). The second group contained parameters that were weighted in proportion to their potential influence on the success or failure of translocation and these values were combined (i.e., the logical UNION operator – Figure 6). For example, this group of parameters considered whether the section was within Critical Habitat Units, an open or closed OHV area, an area considered to be probable for future urban development, whether the area is within a die-off area of resident desert tortoise populations, the level of fragmentation due to open and closed BLM routes, and whether railroad tracks transected the section (Figure 6). The score for each of these parameters was averaged to create a suitability value for the section. This suitability value was then combined with results from the first group to create the decision surface as the results of each scenario that was developed with the model. In this way, none of the UNION parameters were allowed to eliminate a land section in and of themselves, but the combined effect of each parameter in the group influenced the model.

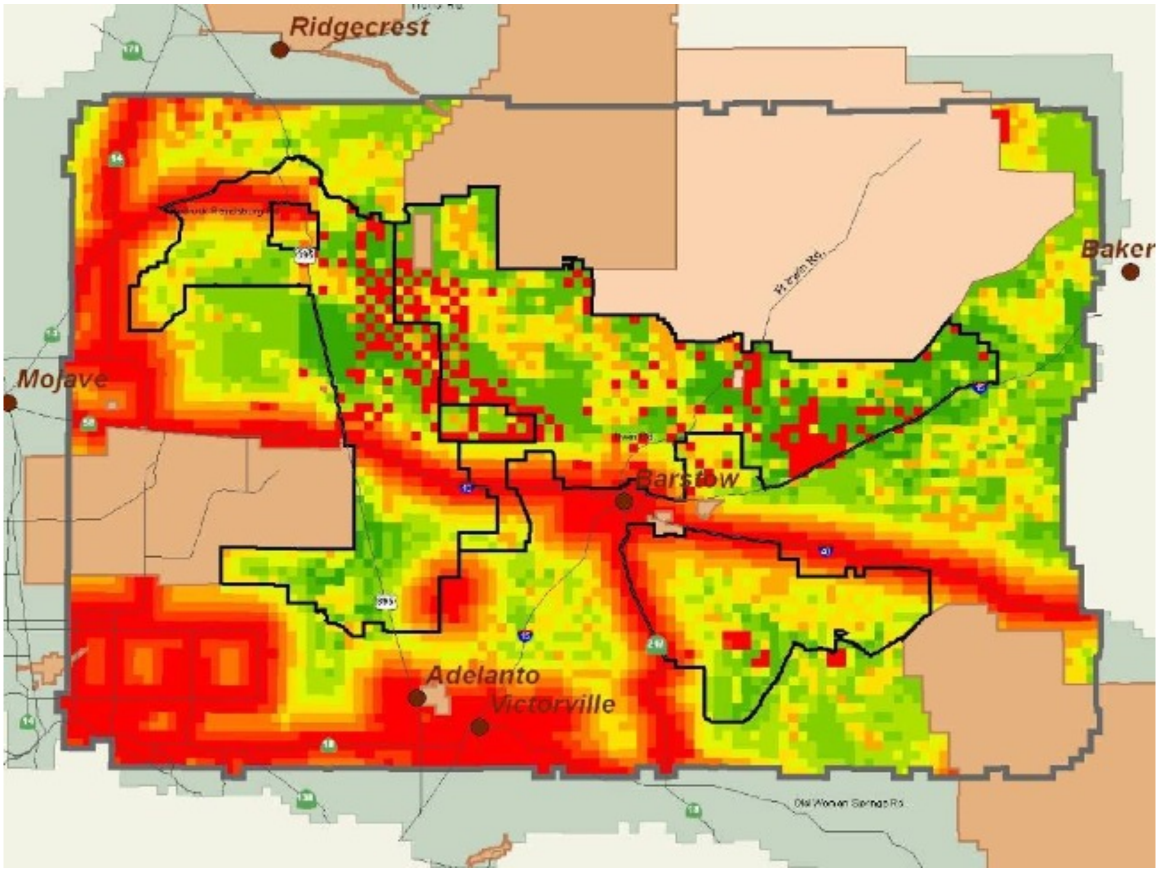


Scenarios

Seven permutations of the input parameters were combined to create modeling scenarios that differed from one another in ways thought to be of particular interest for desert tortoise translocation. These scenarios are summarized in table #######

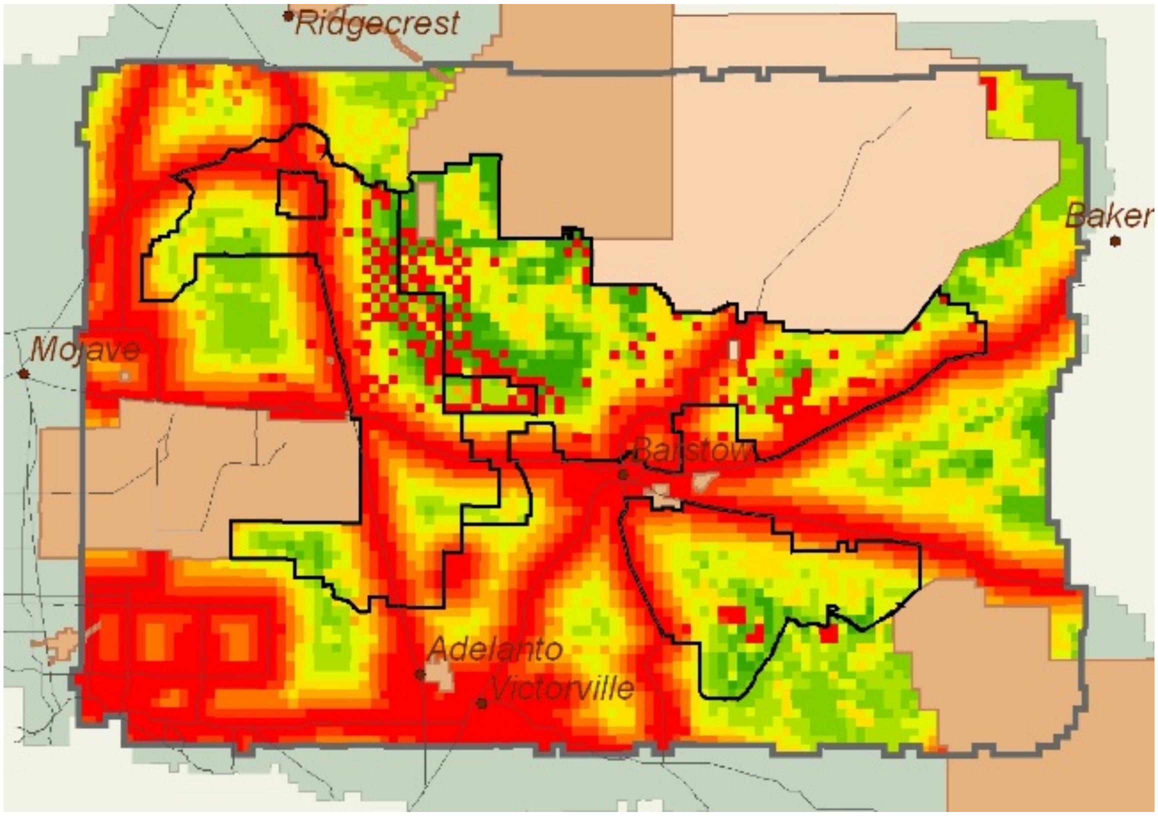
1. I-15, Ft. Irwin Road, Irwin Road, and Route 395 are Fenced

This scenario considered the effects of fencing major highways. Doing this prioritizes sections near the fenced road because of access. This exposes a number of sections that were evaluated as "good" by all criteria other than proximity to major roads.



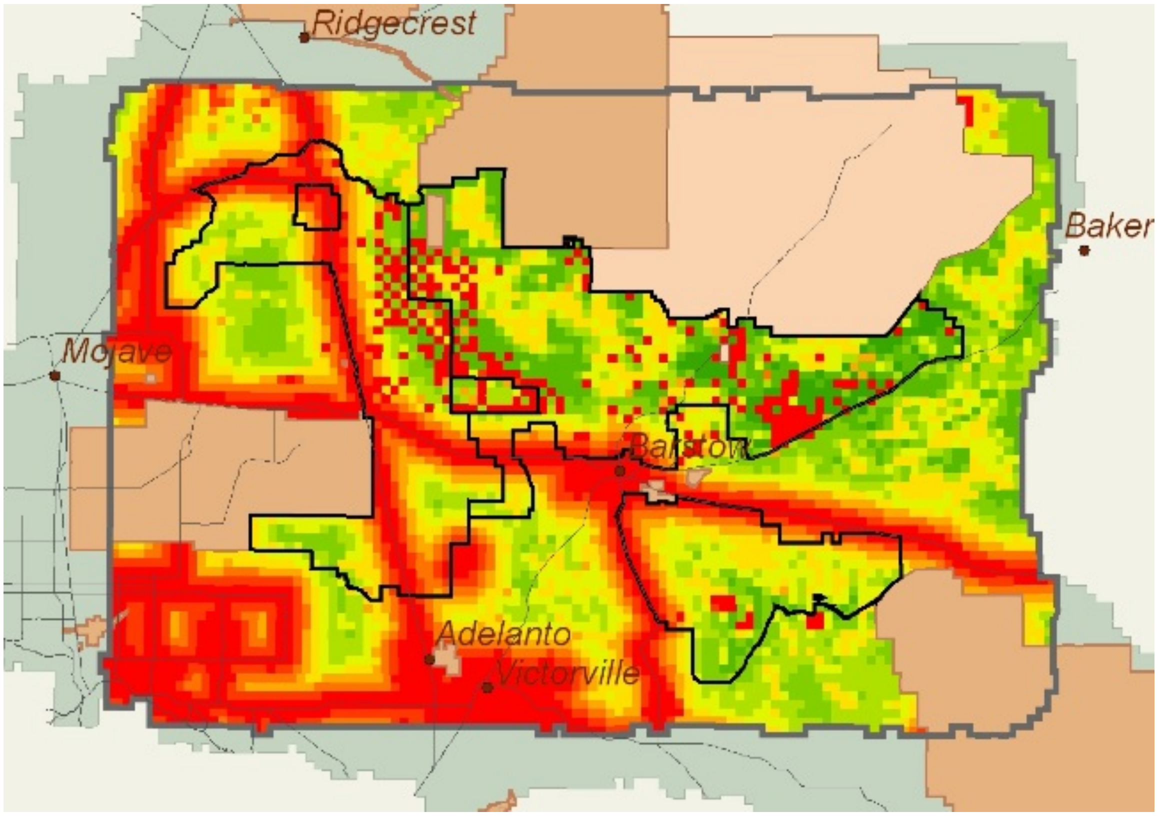
2. Ignore Proximity to Ft. Irwin (genetic)?

This scenario completely ignored the proximity to Fort Irwin (or genetic) criteria of the model. Because the Area of Interest is relatively close to Fort Irwin, this change does not profoundly affect the results. This change slightly increases the value of some sections on the border of the Area of Interest.



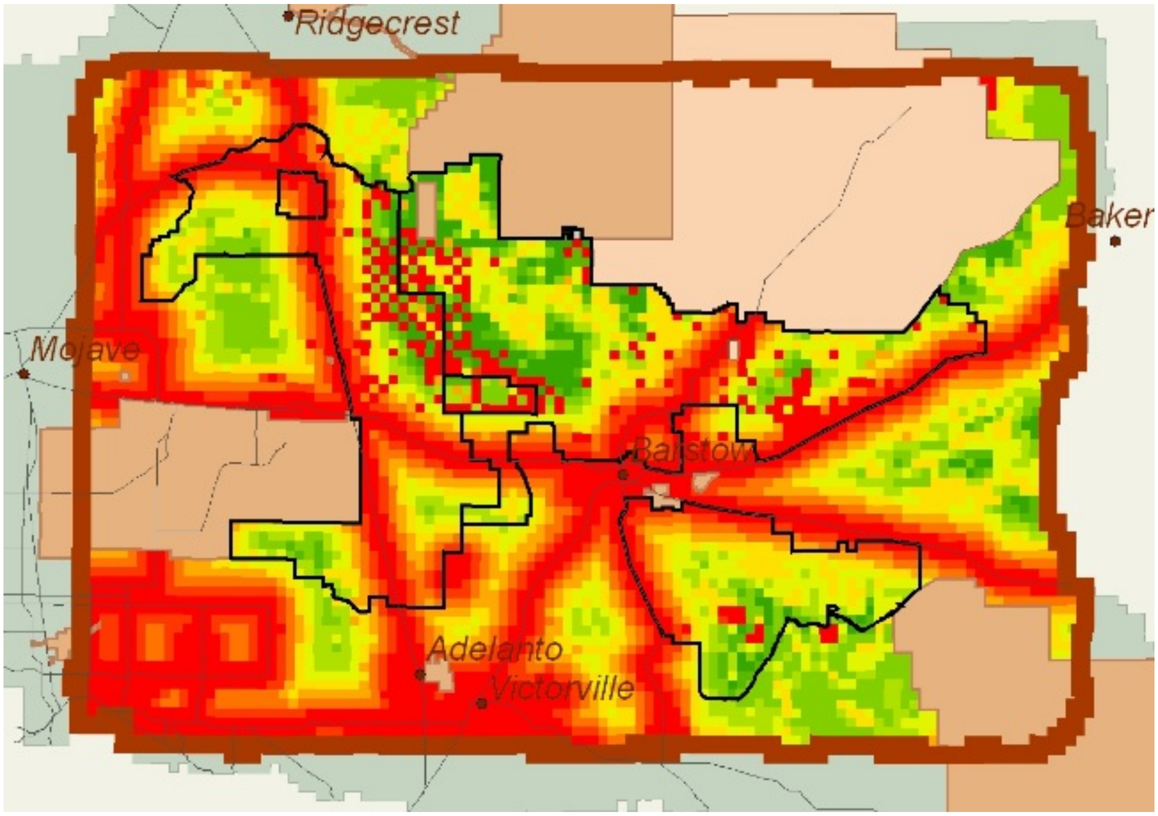
3. Fence Roads and Ignore proximity to Ft. Irwin?

This is a combination of the criteria described in scenarios 1 and 2.



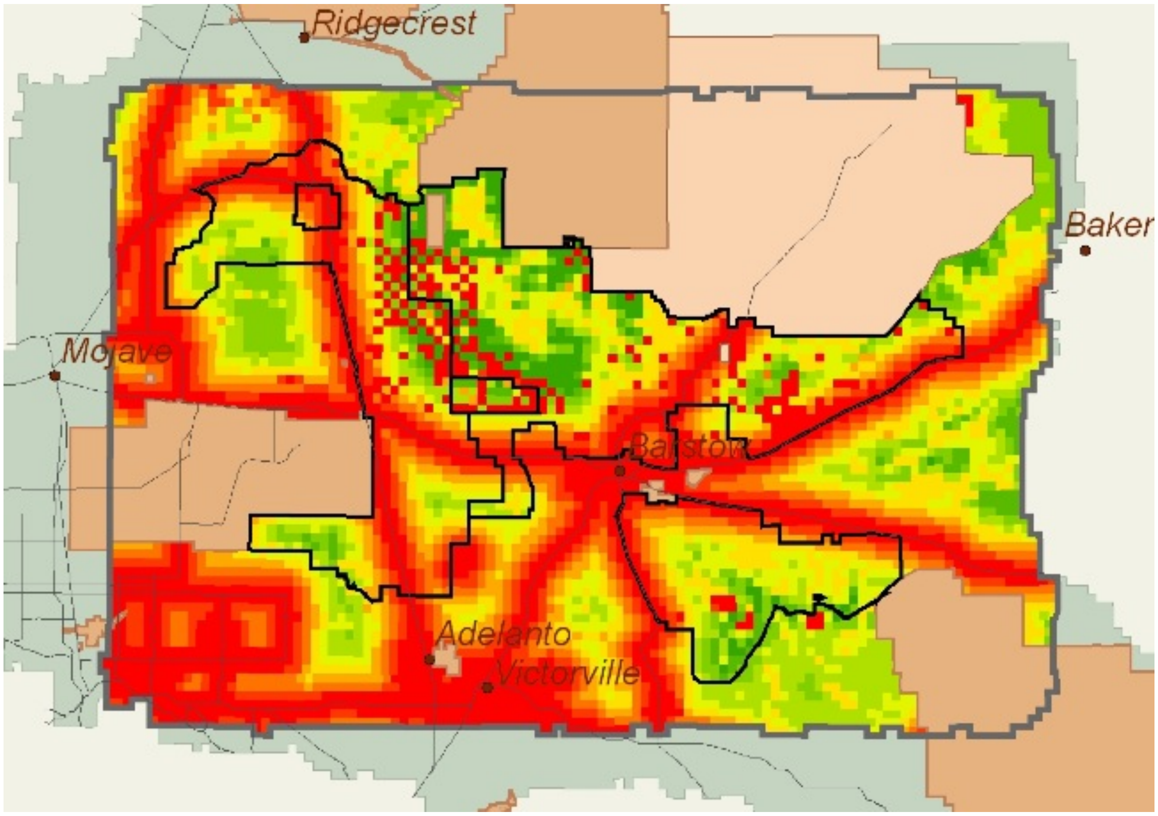
4. Ignore Projected Growth

Because of our lack of knowledge about the projected growth data, a scenario was developed to ignore this criterion. This exposed some sections around existing urban areas whose scores had been diluted by the projected growth data.

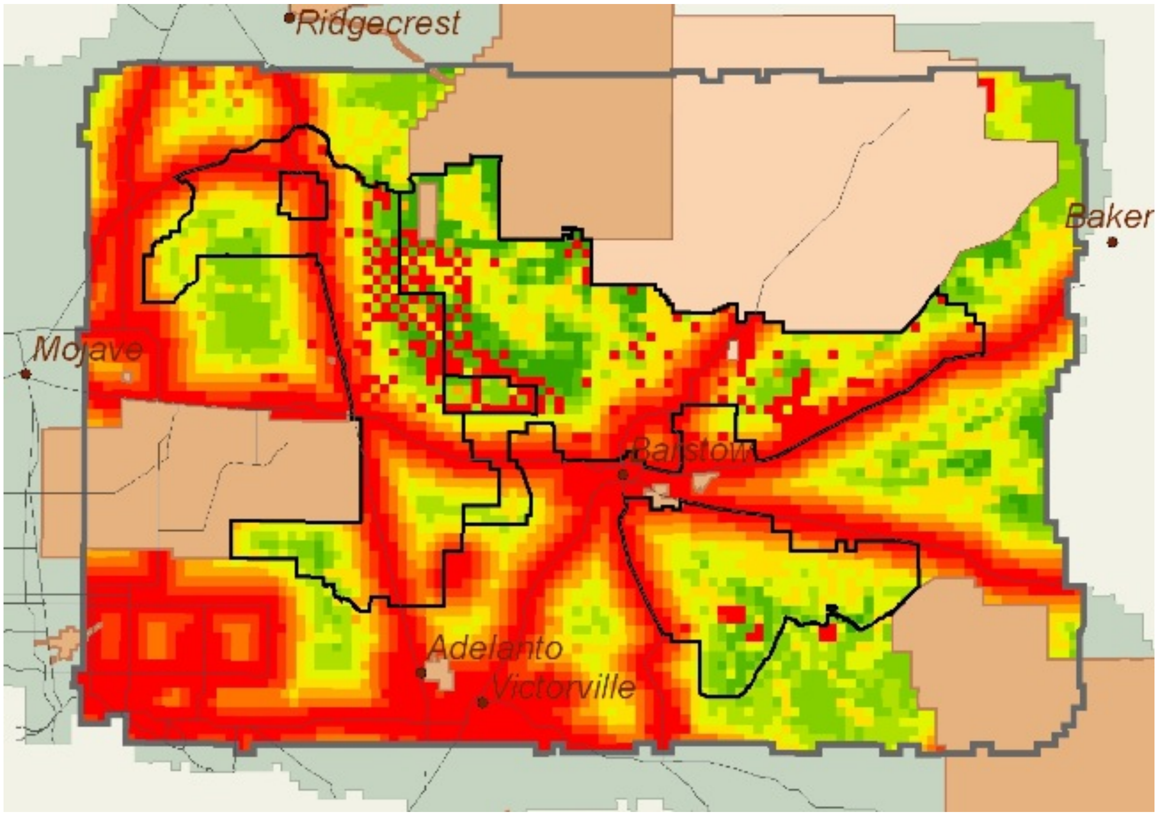


5. Ignore Road Fragmentation and assume closed OHV areas are good

This scenario completely ignored the road fragmentation criterion and reversed the scale of the OHV parameters. This scenario was created to prioritize lands for experimentation of the effects of these factors on the desert tortoise.

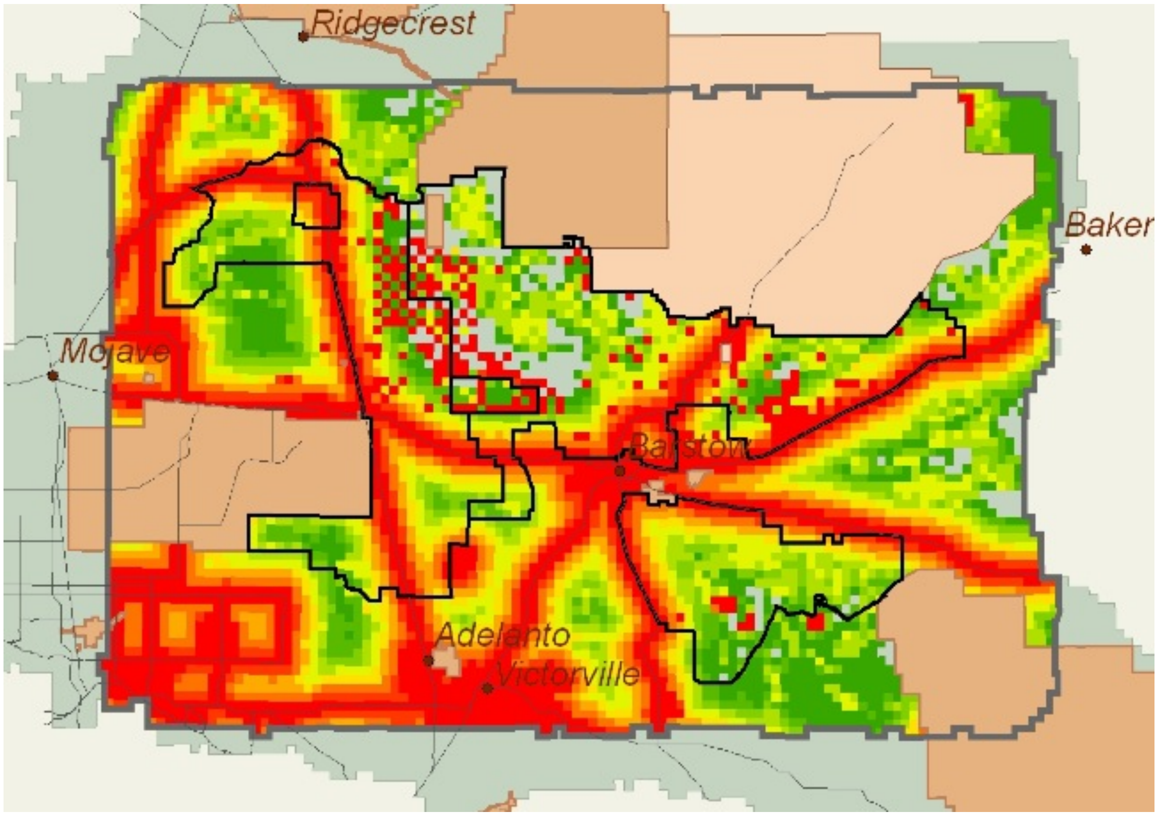

Ridgecrest
Baker
Mojave
Barstow
Adelanto
Victorville

6. Ignore CHU areas



This scenario completely ignored the CHU criterion.

7. Prioritize non die-off areas and assume critical habitat units are bad



This scenario reverses the parameter scales of both the die-off and critical habitat unit criteria.

		Senarios									
		1	2	3	4	5	6	7	8	9	10
Criteria		Fence Rt. 15 and Ft. Irwin Roads	Fence Rt. 15, Ft. Irwin, and 395	Ignore Genetic (Proximity to Ft. Irwin)	Fence 15, Ft Irwin and Ignore Genetic	Ignore Projected Growth	Ignore Road Fragmentation and Assume Closed OHV areas are	Ignore CHU Areas	Prioritize non die-off areas	Ignore die-off areas	Prioritize non die-off areas and assume CHU's are bad
Ownership		x	x	x	x	x	x	x	x	x	x
Urban Proximity		x	x	x	x	x	x	x	x	x	x
Physical	Geomorphology	x	x	x	x	x	x	x	x	x	x
	Elevation/Latitude	x	x	x	x	x	x	x	x	x	x
	Percipitation	x	x	x	x	x	x	x	x	x	x
Roads	Prop. Fenced	x	x		x				x	x	
	Rail/Roads			x		x	x	x			x
	Road Frag	x	x	x	x	x		x	x	x	x
	Prox to Roads	x	x	x	x	x	x	x	x	x	x
Urban	Potent growth	x	x	x	x		x	x	x	x	x
CHU	Good	x	x	x	x	x	x		x	x	
	Bad										x
	Null							x			
OHV	All	x=b	x=b	x=b	x=b	x=b		x=b	x=b	x=b	x=b
	Open						x=b				
	Closed						x=g				
Die-Off	TCS/LDS	x=g	x=g	x=g	x=g	x=g	x=g	x=g	x=b		x=b
Genetics	Prox Ft. Irwin	x	x			x	x	x	x	x	x

x=g Good

x=b Bad

Table Summary of Modeling scenarios used to come up with potential locations for tortoise translocation.

Appendix 4. Photos of Prospective Translocation Areas

Site A


East


North


South


West

Site B

East

North

South

West

Site C

East

North

South

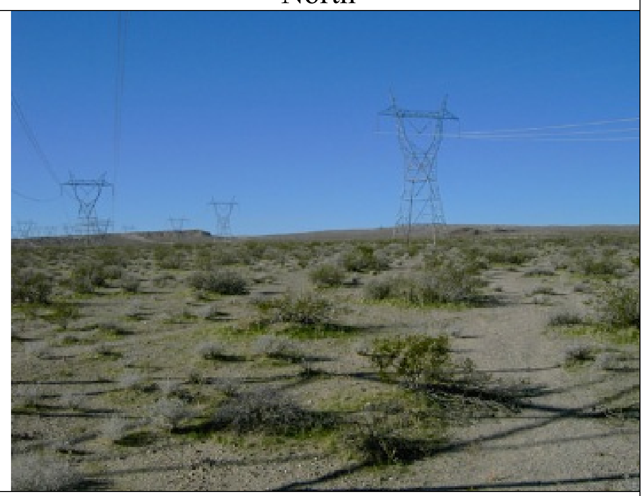
West

Site D

East

North

South



West

Site F

East

North

South

West

Appendix 5. ELISA Positive and Juvenile Desert Tortoise Plan

7/20/2005

Prepared for

U.S. Army National Training Center, Directorate of Public Works

By:

Neil Lynn
ITS Corporation
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Fort Irwin, CA 92310

Introduction

Part of the National Training Center's (NTC) plan to expand its base boundaries is the translocation of the desert tortoises (*Gopherus agassizii*) found in the Southern Expansion Area. A translocation plan covering all aspects of translocating animals has been written and reviewed by various researchers and scientists. A portion of the translocation plan deals with the disposition of the tortoises that are found to be ELISA positive and with juvenile tortoises that are too small to reasonably carry radio transmitters for extended time periods. This plan details how the ELISA positive and juvenile tortoises will be dealt with during the course of the translocation project.

This plan is broken up into two sections; 1) ELISA positive desert tortoises and 2) juvenile desert tortoises found during the clearance surveys of the Southern Expansion Area.

ELISA Positive Desert Tortoises

Upper Respiratory Tract Disease (URTD) played a role in the emergency listing of the tortoise as endangered in 1989 and eventual threatened status listing by the U. S. Fish and Wildlife Service (USFWS) in 1990 (Esque *et al* 2005). This disease may have also played a significant role in the decline of several populations of tortoises throughout the Western Mojave. URTD is characterized in desert tortoises by a nasal discharge, sunken and puffy eyes, and/or a general lethargy. URTD is a chronic disease and tortoises will go through periods of acute symptoms and dormancy. Tortoises could be ELISA positive, indicating that they have been exposed to the disease, but may not be infected with the organisms any longer. Testing in late 1980's and early 1990's showed that the disease is caused by *Mycoplasma agassizii* and is transmittable to other tortoises by direct contact (Brown *et al* 2002).

All desert tortoises found within the expansion areas will have blood samples taken during the fall of 2005 and late spring of 2006 after transmitters are attached. Blood samples will be taken later in the activity season (May through October) to ensure the immune system is active (Jacobson 2000). These samples will be sent to Dr. Elliott Jacobson at the University of Florida-Gainesville for URTD testing. Tortoises that test positive for URTD will be located using radio telemetry and then moved to a quarantine pen for diseased tortoises.

The diseased tortoise quarantine pens will total approximately 140 acres and be located within the UTM 90 East and 500 Meter Corridor conservation areas (Fig. 1). The holding area will be placed in an area that provides ample opportunity for the construction of cover sites and food resources for the tortoises. Prior to placing any tortoises in the holding pen, the area will be surveyed using USFWS accepted methods to determine the levels of tortoise activity in the area. The initial density of tortoises that will be in the quarantine pens will not exceed 200 tortoises/mi^2 (80 tortoises/km^2). Table 1 shows the breakdown of each quarantine pen. Quarantine pen density may be adjusted in the future dependant on consultation with USFWS, CDFG, USGS, and DA. The northernmost quarantine pens (pens 1 and 2) will be used to for tortoises that exhibit clinical signs of URTD and are ELISA positive while the others (pen 3, 4, and 5) will be used for tortoises that are ELISA positive but show no external signs of the disease. No supplemental feeding or watering of the desert tortoises placed in the holding pen will take place unless it is determined by the Working Group that extenuating environmental conditions exist (i.e. extended periods of drought).

Table 1. Breakdown of quarantine pens

Name (North to South)	**Size (Acres)**	***Number of Tortoises***
1	7	*2.3*
2	6	*1.9*
3	45	*14.6*
4	41	*13.3*
5	*40*	*13.0*

This holding pen will be constructed of two parallel desert tortoise-proof fences (1"wide X 2" tall welded wire mesh buried 12" below ground and extending 18" above ground) with a space of 6-12 inches between them (Appendix 6). This double layer of fence will prevent contact of diseased tortoises with tortoises on the outside as well as providing a backup fence should the first fail. In addition to preventing direct contact between tortoises, the mesh size may decrease the mortality from other animals that are trapped within the fence and allow most rainfall runoff to pass through without damaging the fence. With the double fence design, the total length of the fence that will be installed is approximately 13 kilometers.

While the tortoises are being transported they will be kept is darkened boxes and separate from one another. Each box will be disinfected with a 10% bleach solution, or discarded. Tortoises that test ELISA positive for URTD will be moved to holding pen and placed near the center of the enclosure and allowed to disperse throughout the pen. To minimize the stress on the tortoises placed here, tortoises will not be released within sight of each other. When releasing tortoises within the holding area, specific measures will be taken to minimize the environmental stress placed on the animals. Tortoises will be released when air temperatures at 5 centimeters above the ground in the shade are 95 degrees F or less. When possible, tortoises will be released in the morning or evening hours to ensure that temperatures are within acceptable range. As the tortoises are released, they will be placed in existing, unoccupied tortoise burrows, or be placed in the shade of a shrub. Translocation of the ELISA positive tortoises into the quarantine pens will not take place during summer months.

This fence will be monitored every week while tortoises are within the pen. Monitoring will consist of walking the perimeter of the fences to detect any breaks in the line where tortoises could move in or out of the holding area. Monitoring will also be used to detect if tortoises are patrolling the perimeter attempting to escape. As all desert tortoises in the holding pen will be transmittered, each tortoise will be located every 14 to 30 days to assess their condition.

Disposition of the ELISA positive tortoises that are placed in the holding pen will be determined at a later date by the Tortoise Translocation working group. If the diseased tortoises are kept in the holding pen for any extended length of time, they may be used in approved research projects or have any eggs laid in the pen used for head starting programs.

Juvenile Desert Tortoises

During the fall 2005 of the southern expansion area (SEA), juvenile tortoises found will be treated differently than adult tortoises. The cut-off point for juvenile tortoises is 400g. Any tortoise that is below this weight will be treated as a juvenile. Any tortoises over 400 g will be treated as an "adult." Any juvenile tortoises that are found in SEA that are too small to carry a radio transmitter with a one year battery life will be taken out of the field immediately upon locating them. They will then be placed in a climate controlled temporary holding facility located at the Directorate of Public Works-Environmental office or another available office at Fort Irwin while blood samples are sent for ELISA testing. From the time that the juveniles are collected to when their testing results become available, these tortoises will be kept in isolation from one another by placing them in clear "Tupperware" containers roughly the size of a shoebox that are filled with sand, soil, or similar substance. Only one tortoise will be placed in each container at a time. Each tortoise will be monitored daily while in isolation. Disinfection of the containers will occur with a 10% bleach solution before any other tortoises are placed in them.

Juvenile tortoises that are determined to be URTD negative will be moved to either the existing FISS enclosure or a new temporary enclosure to be built at the same location. Movement of juvenile tortoises will have the same climate restrictions as all other tortoises being moved as part of this translocation program. Both the existing FISS and the new temporary enclosures are designed to enclose native vegetation while minimizing surface disturbance. The temporary enclosures are built without a foundation supported by poles 2-3 meters tall. Both the existing facility and the temporary enclosures are designed in such a way as to exclude all predators of juvenile desert tortoises (ravens, coyotes, etc). When the translocation of tortoises to the recipient sites is ready to begin in 2006, the URTD negative juvenile tortoises will be taken from the FISS site and moved to the recipient sites at the same time as the adult tortoises. The juveniles will be transported in the same manner as before.

Diseased juvenile tortoises will be kept in one of the FISS enclosures until such time that they are large enough to be put into the URTD positive pen. UTRD positive juveniles will not be placed in with disease free tortoises.

All juvenile tortoises found will be affixed with specially designed radio transmitters that are small enough as to not induce significant detrimental stress. Due to the small size of these transmitters and the subsequent short battery life, these juvenile transmitters will have to be exchanged out approximately every ten weeks. Juveniles will also be marked using either a Passive Integrated Transducer (PIT) tag and/or fitted with an external label and notched using appropriate standards (ASIH 2004). Juvenile tortoises may be used in future research projects as determined by the Tortoise Translocation Working Group.

Monitoring of the FISS enclosures will occur in the same manner as the diseased tortoise holding pen with weekly trips being made to the enclosures to check for breaches and checking on the overall condition of the enclosure. As with the URTD holding area, no efforts will be made to supplement food or water resources within the enclosure unless the Working Group decides that it is necessary. While the juvenile tortoises are held within the FISS sites, they will be monitored every 14 to 30 days to assess their general condition. As the juvenile tortoises grow to be over 400g, they will then be released to the recipient sites for translocation or otherwise utilized in research.

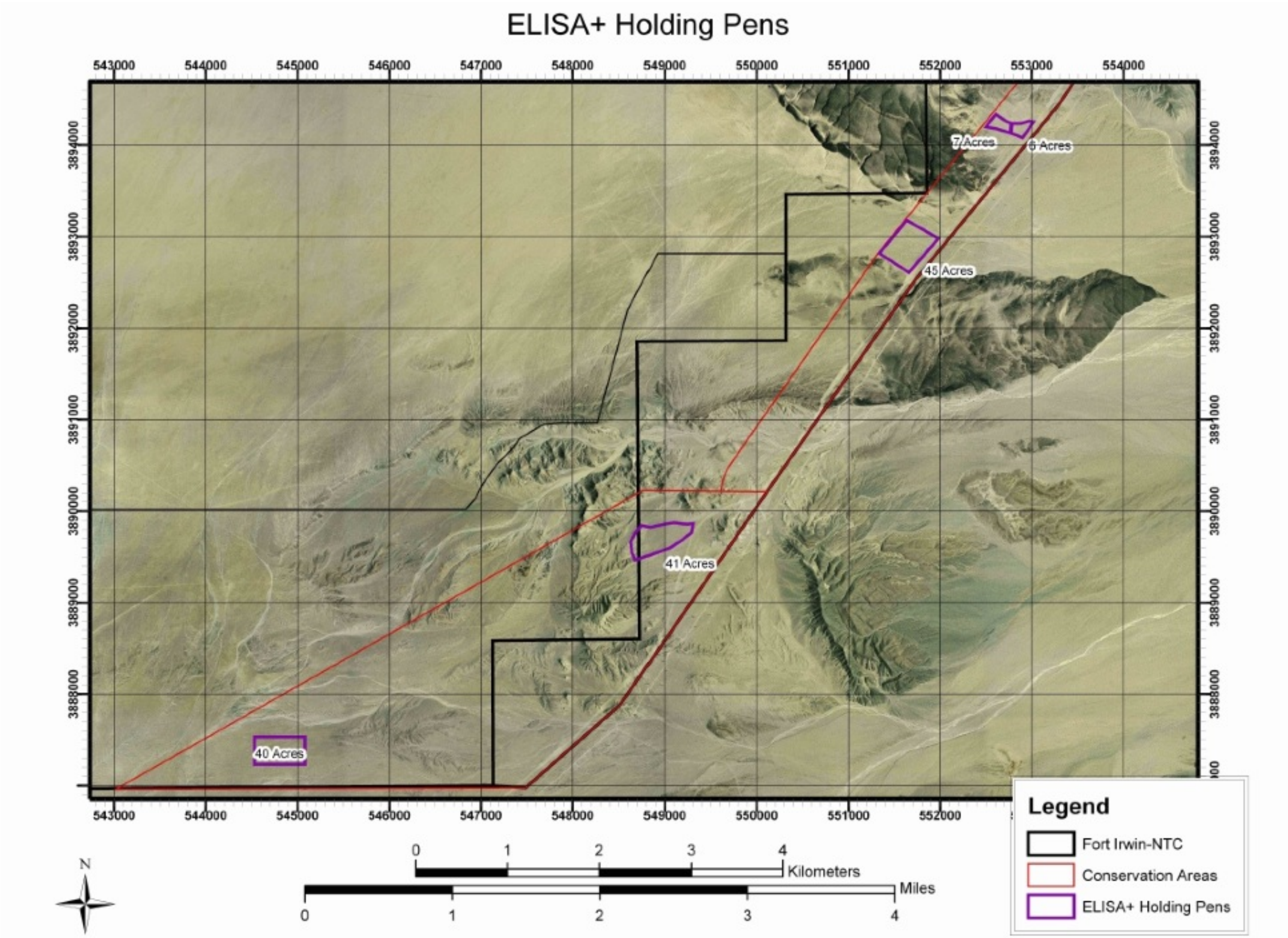

Figure 1. Location of the URTD positive holding pen and FISS site.

Literature Cited

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Appendix 6. Design of Desert Tortoise Proof Fencing

DRAFT
SPECIFICATIONS FOR DESERT TORTOISE EXCLUSION FENCING
June 2005
Michael Burroughs, US Fish and Wildlife Service, Las Vegas, Nevada

These specifications were developed to standardize fence materials and construction procedures to confine tortoises or exclude them from harmful situations, primarily roads and highways. Prior to commencing any field work, all field workers shall comply with all stipulations and measures developed by the jurisdictional land manager and the U.S. Fish and Wildlife Service for conducting such activities in desert tortoise habitat, which will include, at a minimum, completing a desert tortoise education program.

FENCE CONSTRUCTION

Materials

Fences should be constructed with durable materials suitable to resist desert environments, alkaline and acidic soils, wind, and erosion. Fence material shall consist of 1-inch horizontal by 2-inch vertical, galvanized welded wire, 36 inches in width. Other materials include: Hog rings, steel T-posts, and smooth or barbed livestock wire. Hog rings shall be used to attach the fence material to existing strand fence. Steel T-posts (5 to 6-foot) are used for new fence construction. If fence is constructed within the range of bighorn sheep, 6-foot T-posts are required (see New Fence Construction below). Standard smooth livestock wire fencing will be used for new fence construction, on which tortoise-proof fencing will be attached.

Retrofitting Existing Livestock Fence

Option 1 (see enclosed drawing). Fence material will be buried a minimum of 12 inches below the ground surface, leaving 22-24 inches above ground. A trench is dug or a cut made with a blade on heavy equipment to allow 12 inches of fence to be buried below the natural level of the ground. The top end of the tortoise fence shall be secured to the livestock wire with hog rings at 12 to 18-inch intervals. Distances between T-posts should not exceed 10 feet, unless the tortoise fence is being attached to an existing right-of-way fence that has larger interspaces between posts. The fence must be perpendicular to the ground surface, or slightly angled away from the road, towards the side encountered by tortoises. After the fence has been installed and secured to the top wire and T-posts, excavated soil will be replaced and compacted to minimize soil erosion.

Option 2 (see enclosed drawing). In situations where burying the fence is not practical because of rocky or undigable substrate, the fence material shall be bent at a 90E angle to produce a lower section approximately 14 inches wide which will be placed parallel to, and in direct contact with, the ground surface; the remaining 22-inch wide upper section shall be placed vertically against the existing fence, perpendicular to the ground and attached to the existing fence with hog rings at 12 to18-inch intervals. The lower section in contact with the ground shall be placed within the enclosure in the direction of potential tortoise encounters and level with the ground surface. Soil and cobble (approximately 2 to 4 inches in diameter; can use larger rocks where soil is shallow) shall be placed on top of the lower section of fence material on the ground covering it with up to 4 inches of material, leaving a minimum of 18 inches of open space between the cobble surface and the top of the tortoise-proof fence. Care shall be taken to ensure that the fence material parallel to the ground surface is adequately covered and is flush with the ground surface.

New Fence Construction

Options 1 or 2 should be followed except in areas that require special construction and engineering such as wash-out sections (see below). T-posts shall be driven approximately 24 inches below the ground surface spaced approximately 10 feet apart. Livestock wire shall be stretched between the T-posts, 18 to 24 inches above the ground to match the top edge of the fence material; desert tortoise-proof fencing shall be attached to this wire with hog rings placed at 12 to 18-inch intervals. Smooth (barb-less) livestock wire should be used except where grazing occurs.

If fence is constructed within the range of bighorn sheep, two smooth-strand wires are required at the top of the T-post, approximately 4 inches apart, to make the wire(s) more visible to sheep. A 20 to 24-inch gap must exist between the top of the fence material and the lowest smooth-strand wire at the top of the T-post. The lower of the top two smooth-strand wires must be at least 43 inches above the ground surface.

(72-inch T-posts: 24 inches below ground + 18 inches of tortoise fence above ground + 20 to 24-inch gap to lower top wire + 4 inches to upper top wire = 66 to 70 inches).

INSPECTION OF DESERT TORTOISE BARRIERS

The risk level for a desert tortoise encountering a breach in the fence is greatest in the spring and fall, particularly around the time of precipitation including the period during which precipitation occurs and at least several days afterward. All desert tortoise fences and cattle-guards shall be inspected on a regular basis sufficient to maintain an effective barrier to tortoise movement. Inspections shall be documented in writing and include any observations of entrapped animals; repairs needed including bent T-posts, leaning or non-perpendicular fencing, cuts, breaks, and gaps; cattle-guards without escape paths for tortoises or needed maintenance; tortoises and tortoise burrows including carcasses; and recommendations for supplies and equipment needed to complete repairs and maintenance.

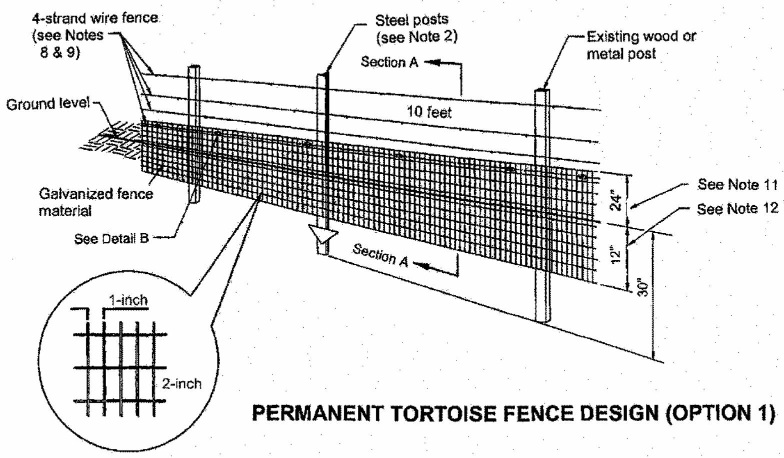
All fence and cattle-guard inventories shall be inspected at least twice per year. However, during the first 2 to 3 years all inspections will be conducted quarterly at a minimum, to identify and document breaches, and problem areas such as wash-outs, vandalism, and cattle-guards that fill-in with soil or gravel. GPS coordinates and mileages from existing highway markers should be recorded in order to pinpoint problem locations and build a database of problem locations that may require more frequent checking. Following 2 to 3 years of initial inspection, subsequent inspections shall focus on known problem areas which will be inspected more frequently than twice per year. In addition to semi-annual inspections, problem areas prone to wash-outs shall be inspected following precipitation that produces potentially fence-damaging water flow. A database of problem areas will be established whereby checking fences in such areas can be done efficiently.

MAINTENANCE AND REPAIR OF DESERT TORTOISE BARRIERS

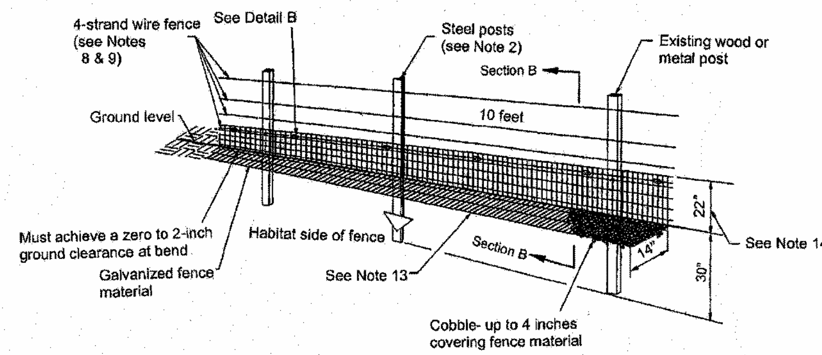
In addition to periodic inspections, debris shall be removed that accumulates along the fence.

Repairs of fence wash-outs: (1) realign the fence out of the wash if possible to avoid the problem area, or (2) re-construct tortoise-proof fencing using techniques that will ensure that an effective desert tortoise barrier is established that will not require frequent repairs and maintenance.
Gaps and breaks will require either: (a) repairs to the existing fence in place, with similar diameter and composition of original material, (b) replacement of the damaged section to the nearest T-post, with new fence material that original fence standards, (c) burying fence, and/or (d) restoring zero ground clearance by filling in gaps or holes under the fence and replacing cobble over fence constructed under Option 2. Tortoise-proof fencing shall be constructed and maintained at cattle-guards to ensure that a desert tortoise barrier exists at all times.

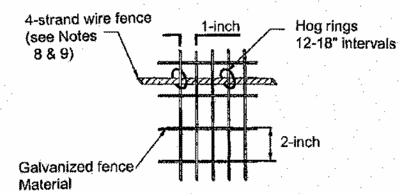
All fence damage shall be repaired in a timely manner to ensure that tortoises do not travel through damaged sections. Similarly, cattle-guards will be cleaned out of deposited material underneath them in a timely manner. All cattle-guards that serve as tortoise barriers shall be installed and maintained to ensure that any tortoise that falls underneath has a path of escape without crossing the intended barrier.



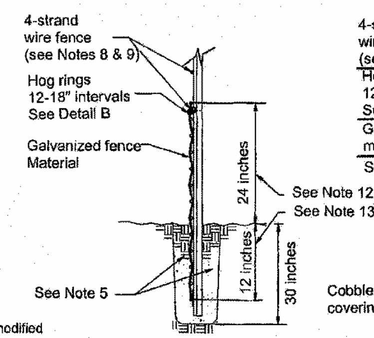
PERMANENT TORTOISE FENCE DESIGN (OPTION 1)



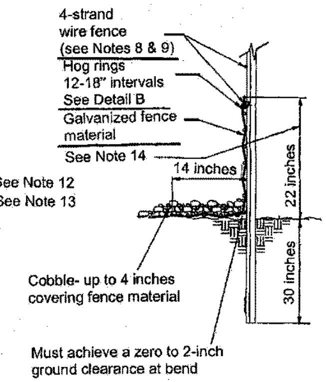
PERMANENT TORTOISE FENCE DESIGN (OPTION 2)



DETAIL B



SECTION A



SECTION B

GENERAL NOTES:

1. Use Option 2 when fence material cannot be placed 6 inches below existing ground level due to rock or caliche substrate
2. Install steel posts when span between existing fence posts exceed 10 feet.
3. Fence posts and materials shall conform with the standards approved by the U.S. Fish and Wildlife Service.
4. Fence material shall be attached to existing fence or wire using hog rings at 12 to 18-inch intervals.
5. Backfill trench with excavated material and compact.
6. Fence material shall be fastened to posts with 3 tie wires with a wire near the top, bottom, and center of the fence material.
7. Attach fence material to all gates. Clearance at base of gate should achieve zero ground clearance.
8. Substitute smooth wire for barbed wire if additional support wires are necessary.
9. The number and placement of support wires may be modified to allow sheep and deer to pass safely through.
10. Fence should tie into existing culverts and cattleguards when determined necessary to allow tortoise passage underneath roadways.
11. Option 1: height above ground level should be no less than 18 inches and no higher than 24 inches.
12. Option 1: depth of fence material below ground level should be no less than 6 inches.
13. Erosion at the edge of the fence material where the fence crosses washes may occur and require appropriate monitoring and repair.
14. Option 2: height above ground level should be no less than 22 inches.

EXHIBIT 449

Amendment to Desert Tortoise Translocation Plan for Fort Irwin's Land Expansion Program at the U. S. Army National Training Center (NTC) & Fort Irwin

Prepared for

U.S. Army National Training Center, Directorate of Public Works

Prepared by:

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1 May 2009

Table of Contents

Acknowledgements

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1. Clearance Procedures for the Western Expansion Area

General Information

The Western Expansion Area (WEA) will be searched in its entirety (250 km^2) using one pass by tortoise survey teams. If >4 adult tortoises are found within one square-km, then that area will be surveyed a second time in its entirety. In an intensive search of a portion of the SEA, we found approximately 70% of the adult tortoises with 2 passes, and >95% with 2 human- plus 2 canine-team passes (Nussear et al. 2008). However, based on apparent densities observed on previous surveys of the Western Expansion Area (WEA), the decision was made to limit surveys in low-density areas and repeat surveys in grid cells (1km^2) on which >4 tortoises are found. Tortoises remaining in the WEA post-translocation will be subject to safety protocols in place for the rest of the National Training Center.

Removal of tortoises from the WEA must begin by Spring 2010 and be completed by Spring 2011 if military activities are to commence by July 2011 (see Appendix 1 - Timeline). This requires determining the number of tortoises in the WEA, and complete preparation of translocation sites (selection of specific release sites, screening the health of resident tortoises, planning for fencing where required, contracting, etc.). Tortoises will be counted and disease testing of tortoises in the WEA will be completed by fall of 2010. Permits and authorizations for all activities related to tortoise capture and handling will be acquired prior to any surveys from appropriate agencies (i.e., Fish and Wildlife Service, California Department of Fish and Game, and Bureau of Land Management). All work identified below is subject to state and federal permits and may be altered or modified to meet permit conditions or based on new information, as appropriate.

The development of this document was guided by input from a variety of sources beyond that of the authors and contributors. Other sources included guidelines from the IUCN (1998), and the Science Advisory Committee to the US Fish and Wildlife Service, Desert Tortoise Recovery Office, and several anonymous reviewers.

WEA Clearances

Tortoise Encounter Procedures

Upon locating each tortoise during surveys the following information will be recorded: date and time tortoise is located, sex, location of each animal (determined using a GPS), air temperature at 5cm above the ground, tortoise identity (see below), carapace length (mm), mass (g), general notes on appearance and health/condition. All data will be recorded on standardized data sheets provided in this document (Appendix 2A) and input into the online database at www.deserttortoise.gov/dtsm.

Tortoises found during clearance surveys will be fitted with an external label and notched using the highly modified Honeggar System (Appendix 2B), and adult tortoises will have a light-weight radio transmitter attached with a battery life of at least two years. Smaller tortoises are to be fitted with transmitters with an 11- or 12-based on new information, as appropriate month battery life. Transmitters will be attached using methods similar to those described in Boarman et al. (1998). All transmittered tortoises will be monitored at least monthly until they are translocated to a release site. Approved handling techniques will be used as required by the State and Federal permits. After processing and data collection, tortoises will be released as soon as possible at the point of capture. Time of release will also be recorded.

All tortoises that are too small to receive an 11 or 12-month transmitter will be removed from the field and transported to a temporary outdoor holding facility. The holding facility will be maintained according to all legal and ethical requirements for treatment of captive animals (e.g., Animal Care and Use Guidelines from an official university ACUC program, ASIH 2004).

Health Screening Of Tortoises Prior to Translocation

All tortoises (juvenile and adult) will be inspected for clinical signs of upper respiratory tract disease (URTD), signs of a herpesvirus infection (lesions in the mouth), or signs of other debilitating diseases. Minimally, blood samples will be collected for laboratory analysis; collection of additional biomedical samples may be added as approved techniques for monitoring desert tortoise health are developed. For example, although diagnostic tools for the identification of herpesvirus in some tortoise species have been developed, there are currently no diagnostic tools that have been shown to confirm the presence of herpesvirus in desert tortoises. Based on discussions among CMWG members, the development and validation of diagnostic herpesvirus tools seems imminent (University of Florida – Small Animal Clinical Sciences 2009). Should they become available they will be added to the toolkit for diagnosing disease. In the meantime it is likely that field samples will be requested for testing and this project is prepared to accommodate some of that work. Future references to herpesvirus work in this document should all be considered with this in mind.

Only healthy tortoises will be translocated, although classifying individual tortoises as sick or healthy includes uncertainties. For the purposes of this translocation, “healthy” tortoises are defined as those: a) lacking clinical signs of acute infection and; either b) testing negative for *Mycoplasma testudineum*, *M. agassizii*, and herpesvirus antibodies using an ELISA test (similar to Martel et al. 2009, but requiring testing on desert tortoises before approval as an appropriate test for determining the fate of animals in this program), or; c) if testing positive to *M. agassizii*, and herpesvirus antibodies with the ELISA test, showing a natural antibody response with a Western blot (Hunter et al. 2008) and Polymerase Chain Reaction (PCR), respectively. Complete details for conducting health evaluations on desert tortoises are provided in Appendix 3.

Monitoring of Tortoises

Tortoises will be tracked at least monthly in the WEA until they are picked up and moved to the translocation area. Upon locating each animal the following data will be recorded: tortoise number, date, time, location (acquired with a GPS), general location description, temperature (ºC, measured at 5 cm above ground as per permit terms and conditions). Any pertinent information related to any change in the condition or health status of the individual will also be recorded upon locating each animal, if possible. These are the minimal data to be collected, and the needs may be increased with further discussion.

Western Translocation Area (WETA)

The area considered for prospective translocation covers 1,153.6 km^2 to the southwest of the National Training Center at Fort Irwin (NTC) in southern California, USA, which is entirely within the Superior Cronese Critical Habitat Unit (Figure 1). Criteria for prioritizing potential translocation sites included biological and anthropogenic factors affecting desert tortoise populations in the Western Mojave Desert Tortoise Recovery Unit. We identified the translocation area by considering potential release sites relative to land ownership, habitat, proximity to unfenced roads and highways, proximity to urban areas, road density, potential areas with depleted tortoise populations, and utility corridors. The site-selection decision support model is described in Appendix 4. The areas selected for desert tortoise translocation include any map unit (square-mile sections on Figure 2) with a weighted value greater than 0.5, which includes all green-shaded areas and indicates that these would be the most favorable sites for translocation, considering all of the criteria identified. Only lands owned and managed by the Army or BLM shall be used for translocation sites. State lands are not being considered due to administrative burden related to such activities.

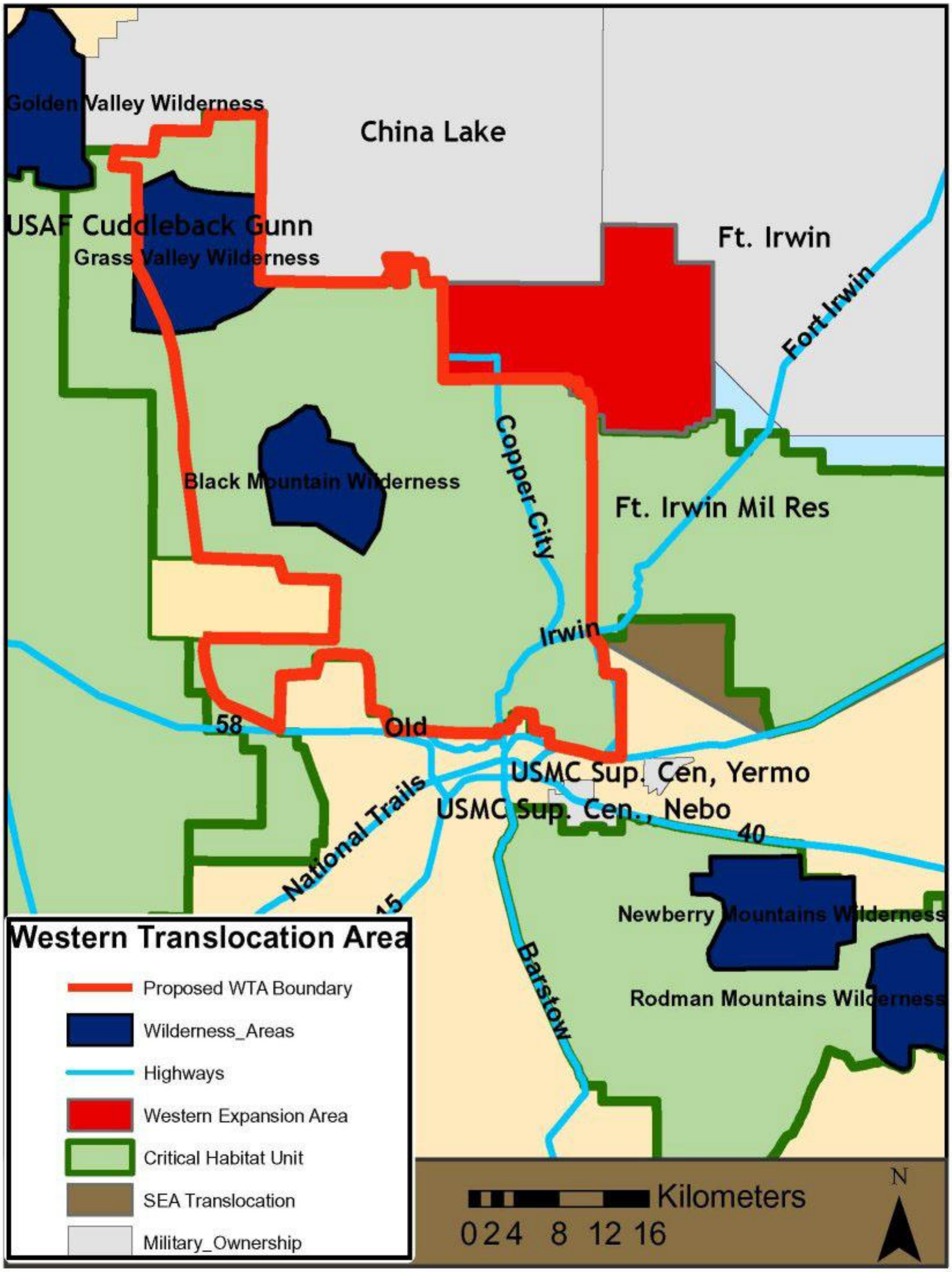

Figure 1. Location of the area considered for translocation of tortoises from the WEA.

One important topic for the translocation of desert tortoise is the disease status of those tortoises being translocated versus the disease status of the resident tortoises in the area where other will be translocated to. This is a topic of current debate in wildlife management and the issue must be balanced with respect to many factors regarding translocation which we consider here. The fact that disease occurs in the WETA may or may not be a problem for translocated tortoises, especially in light of the fact that disease also exists in the WEA. Thus, the animals that are proposed to be translocated are at risk of disease exposure in either location. Anonymous reviewers of this plan (in addition to the original translocation plan) noted that if tortoises reside in a population where disease is present, then it may make no difference if they are translocated into a population with disease. Furthermore, technically, these animals are all part of the same population as there are no known geographic or genetic barriers between the two areas where tortoises occur at this time, thus one would expect tortoises and disease to move through the area over time. One of the benefits of the 5 yr monitoring program for the WETA, and continued monitoring of tortoises in the Southern Translocation Area, is to determine if this is a problem worth worrying about during future management actions.

Disease Testing of Resident Animals in the WETA

Preliminary results of disease surveys in the Western Expansion Translocation Area (WETA; Berry 2009) indicated that a more thorough and complete survey is required to capture the spatial distribution of disease in the WETA. Data from the disease surveys conducted during the Southern Expansion Area clearances and from the residents in the southern translocation area were analyzed to determine the scale of autocorrelation in the presence of disease. For this analysis, we compared the spatial distribution of animals that tested positive or suspect with those animals that were considered negative using ELISA-based tests for *Mycoplasma agassizii* and *M. testudineum*. The analysis was used to evaluate the likelihood that sick versus healthy tortoises are clustered and if we could identify clusters where disease is prevalent. Areas of disease prevalence could then be avoided while deciding where to place translocated animals. To accomplish this we analyzed the presence/absence of disease using spatial glm (sglm) with binomial error distributions using R (version 2.8.1, R Development Core Team 2009) and the geoRglm package (version 0.8-24, Christensen and Ribeiro 2002). Estimates indicated that the presence or absence of disease as measured by animals that tested positive or suspect was spatially autocorrelated, with an effective range of ~ 5 km (Figure 3). This indicated that in order to sample the WETA with sufficient precision to detect areas that contained clusters of potentially diseased animals we should sample the area at this scale. We selected center points within a regular grid of sections in the WETA that were predicted to be suitable for translocation such that the maximum distance diagonally between sampling locations was 5-km (Figure 4). Where the pattern of suitable sections on the landscape caused larger areas not to be sampled we adjusted the sampling grid accordingly. This resulted in a pattern of 64 sample points within alternating sections within which health sampling of tortoises should be conducted. The goal of the health surveys should be to find animals for health surveys in and around the sample points, and not 100% coverage of the sections themselves.

Each survey will include walking surveys at 7.5 m intervals throughout each selected survey area (2.6 km^2). A minimum of 10-15 tortoises should be located on each survey area. Each animal encountered will have full health surveys and sufficient blood sample collected for analysis of known pathogens including: *M. agassizii*, *M. testudinium*, and herpesvirus ELISA, PCR and Western Blot where applicable.

If a sampling location containing diseased resident animals (including suspect laboratory test results) is detected during disease sampling in the WETA, then a 5 km buffer will be placed around the "diseased" animal(s). Translocated tortoises will not be released within this 5 km buffer. Buffer size was determined by an analysis of the spatial distribution of disease found in the SEA (Fig 3). This distance is also one-half the average first-year, straight-line distance moved by translocated tortoises as reported by Field (1999), Nussear (2004), and SEA translocation monitoring (Drake et al. 2009, Berry 2009, Walde et al. 2009). This will minimize

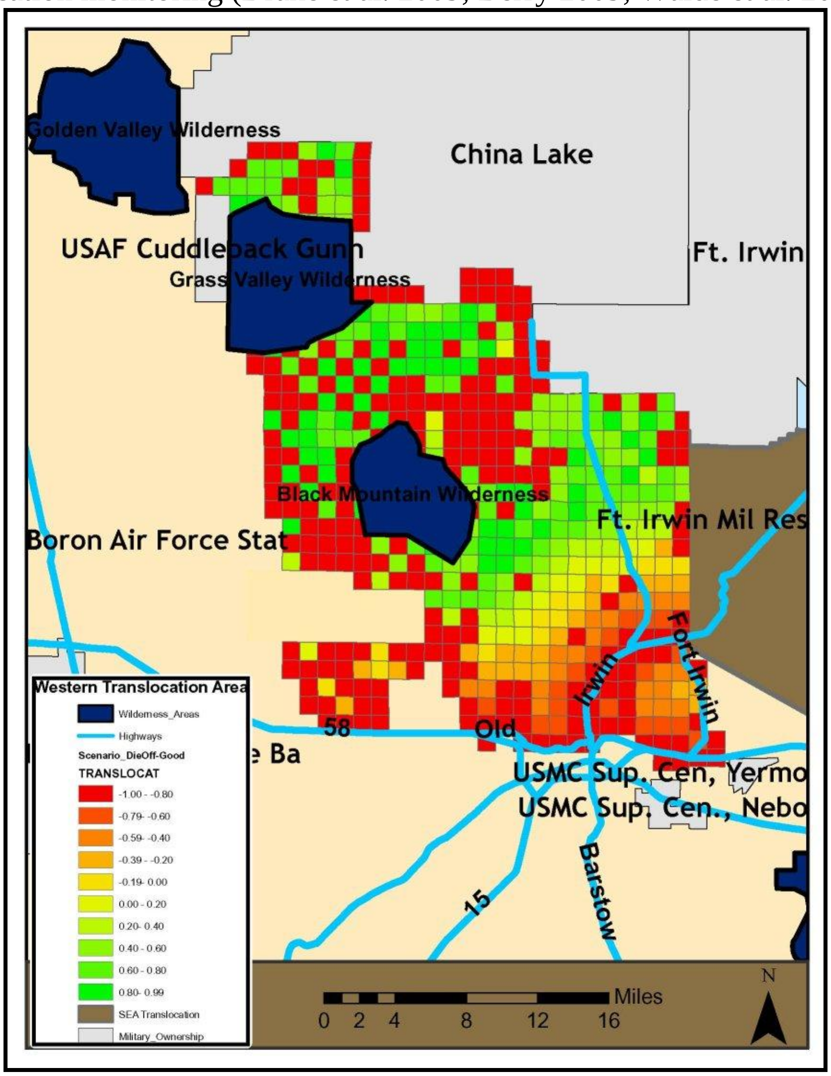

Figure 2. Results from the Translocation Suitability model for the Western Translocation Area. Colors indicate suitability where red is considered unsuitable through green considered highly suitable.

buffer. Buffer size was determined by an analysis of the spatial distribution of disease found in the SEA (Fig 3). This distance is also one-half the average first-year, straight-line distance moved by translocated tortoises as reported by Field (1999), Nussear (2004), and SEA

translocation monitoring (Drake et al. 2009, Berry 2009, Walde et al. 2009). This will minimize contacts between translocated tortoises and potentially ill resident tortoises, thus minimizing the risk of spreading of disease in the WETA. If additional release sites are required for this translocation action, a re-evaluation of disease sampling around affected areas should be conducted.

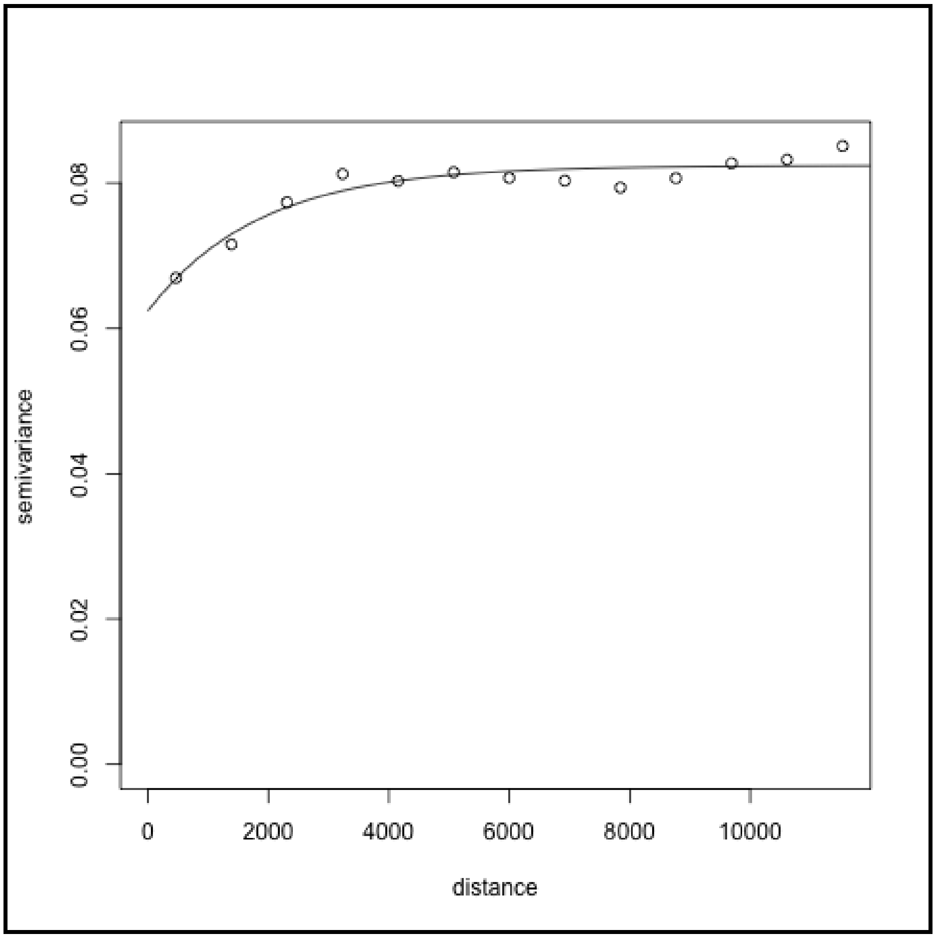

Figure 3: Semivariogram showing the autocorrelation in the spatial aggregation of positive/suspect and negative tortoises for Mycoplasma agassizii and M. testudineum as evaluated by ELISA. Here, lower semivariance indicates a higher covarriance among animals that are closer together, leveling off at approximately 5,000 meter distance (5km).

Predation and Predator Control

High levels of predation were observed immediately prior to and subsequent to translocation from the southern expansion area. Analyses of the southern expansion area data indicated that translocated tortoises were not preyed upon differently from resident tortoises or resident control animals that were at large in the area (Esque et al. Unpublished Data). Moreover, additional data from more than 10 sites spanning the Mojave Desert and representing sample populations of desert tortoises that were monitored throughout the Mojave Desert in the same time period as the translocation illustrate that very high predation rates were Mojave Desert-wide in their extent (Esque et al. Unpublished Data). Although on-the-ground predator control was initiated in 2008, it was not possible to identify offending individual predators, and only minimal results on coyote control were obtained (2 coyotes removed). Under these and related circumstances, predator control is unlikely to be successful for protection of desert tortoises in relation to this particular project (Goodrich and Buskirk 1995). The U.S. Fish and Wildlife Desert Tortoise Recovery Office Science Advisory Committee (DTRO-

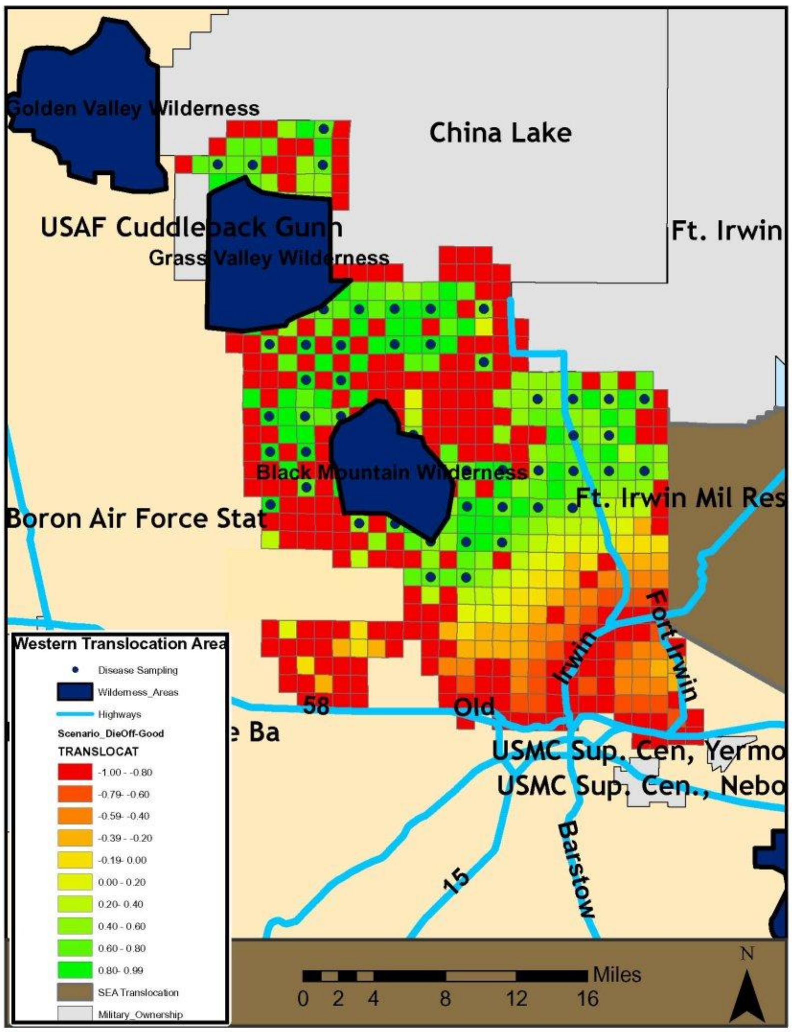

Figure 4. Results from the Translocation Suitability model for the Western Translocation Area. Colors indicate suitability, where red is considered unsuitable through green considered highly suitable. Blue circles indicate the center of selected disease sampling areas.

SAC) recommended that large-scale predator control is not a valid management action, based on a lack of evidence of its effectiveness, unless conducted under an experimental design.

Fencing and Other Considerations

No additional fencing is scheduled to occur in relation to the removal of tortoises from the WEA and into the WETA. The CMWG considered fencing the section of Old Irwin Road that crosses the southeast corner of the WETA. If it were possible to fence that area, fewer desert tortoises would likely be killed attempting to cross the road. However, after extensive discussions between the Army and the County, fencing was considered to be logistically unfeasible due to the propensity of the area to sheet flood and the resultant extensive washouts of fencing. Investing in fencing that area of highway would only provide a false sense of security because the county could not assume the cost of maintaining the fence. The southern and eastern boundary of Naval the Air Weapons Station, China Lake, will be fenced to prevent desert tortoises from entering Fort Irwin from the weapons station.

2. Translocation Procedures

Selection of recipient sites (by CMWG) and all pertinent inter-agency agreements will be finalized prior to translocation of animals. In addition, the Army will coordinate with any ongoing research in the area. The need for fencing of any tortoise containment facilities will be identified so that construction of those fences can be planned, contracted, implemented and completed in time for the sites to receive tortoises from the expansion areas prior to training activities (see Appendix 1, Time Line of Activities).

Disposition and Distribution of Desert Tortoises from the WEA

Those tortoises found to be healthy (Appendix 3) will be moved to predetermined, dispersed release points within the Western Expansion Translocation Area (WETA). Tortoises will be dispersed in a regular pattern throughout the WETA so that tortoise densities will remain as low as possible. Tortoises will not be purposefully re-distributed randomly, whenever possible, they will be released in cohorts that include individuals that were collected in proximity to one another. There were ~ 205 sections that were identified by the model to have a suitability value of 0.5 or higher, indicating that these would be the most favorable sites for translocation, considering all of the criteria identified (Figure 2). Selected suitable habitat sections will be evaluated and ground-truthed by qualified personnel prior to translocation under the auspices of the U.S. Fish and Wildlife Service and California Department of Fish and Game. Current estimates indicate that as many as 1,000 adult tortoises (MCL>180mm) will need to be translocated from the WEA (Walde et al. 2009). If all of these animals are healthy and all sites are suitable for translocation, we will need to translocate approximately 4 animals per section to distribute them evenly across the suitable landscape. However, should there be any areas excluded by buffering diseased resident tortoises in the WETA, then the total area available for translocation will be decreased and the release density of tortoises in each area will increase accordingly.

Translocation Procedures

Translocations will only occur in the spring (i.e., March – early May) and fall (i.e., late September to mid-October), to avoid extremely high or low temperatures (Cook et al. 1978, Nussear 2004). Tortoises will not be released in the summer (i.e., June - August), or winter (i.e. late November through February) for any reason. No desert tortoise will be captured, moved, transported, released, or purposefully caused to leave its burrow for whatever reason when the ambient air temperature is above 95 degrees Fahrenheit (35 degrees Celsius). No desert tortoise will be captured if the ambient air temperature is anticipated to exceed 95 degrees Fahrenheit before handling or processing can be completed. Tortoises found in burrows will be “tapped” to encourage them to exit (Medica et al. 1986) or they may require careful excavation. Multiple visits will be necessary if tortoises are inaccessible in caves. Tortoises with radios that were attached during clearances or other activities will be collected from field sites and transported in vehicles or helicopters to the translocation sites by biologists that have been approved by the U.S. Fish and Wildlife Service and California Department of Fish and Game to handle desert tortoises, and released within 24 hours. Juvenile tortoises (those too small for radio attachment) housed elsewhere after clearance, will be translocated at this time as well. During translocation, tortoises will be transported in clean, disinfected protective containers to ensure their safety during translocation. If re-used, these containers will be disinfected using a 10% bleach solution before being used to translocate other tortoises.

Upon release, any tortoise that defecated will be rinsed with clean water. All tortoises will be provided drinking water for 30 minutes and will then be released into an unoccupied tortoise burrow (if available) or in the shade of a shrub. Previously, desert tortoises released into artificially made burrows showed no fidelity to those sites, often leaving them immediately (Field 1999, Nussear 2004, Boarman et al., unpubl. data). Suitability of release depends on the severity of the daily ambient temperature at the time of release (Lohoefener and Lohmeier 1986, Corn 1991, Field 1999, Nussear 2004).

In previous studies on translocation, animals were observed after release under similar conditions to those proposed herein, and virtually all those animals were able to find suitable shade resources generally without showing signs of overheating or thermal duress; only two individuals showed temporary signs of thermal stress, by frothing, but both of them survived this episode (Field 1999, Nussear 2004). More recently, during the southern area expansion translocation of >640 adult tortoises, two were observed to exhibit behaviors related to overheating and subsequently one of those individuals died (K. Berry per comm.). Thus, it is imperative that these procedures be followed and desert tortoises be monitored for signs of problems even when conditions seem conducive to translocation.

A subset of tortoises (20%) will remain equipped with transmitters upon release and will be monitored with a similar cohort of residents and resident control animals at least biweekly for the first year after the translocation (see subsequent section on post-translocation monitoring in the WETA). Thereafter, tortoises will be monitored at least monthly for a period of 5 years.

Post-translocation Disposition of Tortoises in the WEA

Tortoises that are not found during the clearances of the expansion areas may be encountered at a later date during military training or other activities. Tortoises found in the WEA after the translocation will be left in place unless they need to be moved from imminent danger if encountered as per current Directorate of Public Works (DPW) procedures on the National Training Center (NTC).

Monitoring Design for Resident Tortoises in the WETA

Guidance from the CMWG has indicated that post-translocation monitoring of tortoise populations in the WETA is warranted in order to be consistent with the basic tenets of the Translocation Plan: 1) humane treatment of desert tortoises; 2) contribute to the conservation of the species by adding to the knowledge base; and 3) incorporating the most up-to-date and best science practices in all activities. After the first year, tortoises should be monitored at least monthly for a period of 5 years. With this in mind additional hypothesis-driven monitoring in the WETA should focus on basic health and well-being of the tortoises involved while providing new information and testing tools when logistically and fiscally feasible. The monitoring program will include basic assessments of survival of the affected and control populations, fundamental measurements of tortoise movement and behavior, testing of basic and experimental health physiology profiles, and development of new tools for tortoise conservation.

Although monitoring the population with controls is costly, it has also proved to be one of the most important tools for understanding the potential effects of translocation versus other factors that can affect tortoise populations. Although translocation is a large focus of the work with these animals, the southern expansion area translocation illustrated how changes in local land use, other management activities, and direct or indirect results of environmental changes can also affect the tortoises and can have important ramifications for the translocated population. When properly designed, information on the movement and behavior parameters are acquired with little cost if the bi-weekly (first year) and monthly (thereafter) monitoring of tortoise survival and locations is properly organized. Basic health profiles for known tortoise diseases such as *Mycoplasma* spp. and various strains of herpesvirus will be taken annually at a minimum.

Considering all these factors, the best monitoring design incorporates 3 populations of tortoises for monitoring which is consistent with the design in the Southern Expansion Translocation Area (SETA). This design can accommodate a variety of research questions and has already proven very important during the translocation in the SETA. One year of post-translocation experience has illustrated that this design has successfully handled unforeseen problems that arose due to excessive predation across the desert (Esque et al. *Unpublished Data*). The 3 populations include the translocatees, residents, and resident control animals (Esque et al. 2005). The overall design will require slight modifications because of general differences in the translocation that have already been accepted by the CMWG. For example, the dispersed releases of tortoises could compromise the integrity of control tortoises. To resolve this potentially confounding fact, we plan to study tortoises in Wilderness areas as control animals with perhaps some additional animals spread throughout the study area. In addition, any ELISA-positive tortoise with an innate-immunity banding pattern that is translocated (see below) should be monitored. We expect this design to include all ~1100 translocatees (Walde et al. 2009). We plan to sample and monitor 20% of those tortoises and to study comparable numbers of residents and control animals for a total of somewhere near 660 tortoises in the monitoring program.

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Appendix 1. Time Line of Activities Related to the Translocation of Desert Tortoises.

a. Spring 2009

Evaluation of potential recipient areas
Interagency agreements, i.e., NEPA, land uses and right-of-ways
Apply for State and Federal permits
Apply for animal care and use committee approval for animals held in captivity
Order equipment (transmitters may take 6 month prep time)
Fencing plans in place for conservation research area
Test and telemeter residents in the recipient sites and begin monitoring them

> Note: the timing on disease testing dictates that tortoises tested in one season (e.g. spring or fall) are not eligible for activities involving other tortoises until the subsequent season (fall or spring, respectively).

Collect baseline environmental data on WEA and recipient sites
Build juvenile tortoise holding pens
Continue surveys and radio attachment in WETA
Sample residents for disease in WETA

b. Fall 2009

Begin full scale surveys in the WEA / radio attachment / blood work at WEA
Place juvenile tortoises in holding pens within an outdoor facility
Annual review with Conservation Mitigation Working Group
Blood sampling in WETA
Finish translocation all remaining SEA tortoises

c. Spring 2010

Continue clearance surveys / radio attachment / blood sampling at all WETA recipient sites
Begin translocation tortoises from WEA if possible
Blood sampling in WEA

d. Fall 2010

Continue translocating tortoises from WEA
Annual review with Conservation Mitigation Working Group

e. Spring 2011

Complete translocating tortoises from WEA

f. Summer 2011

Military training begins

g. Fall 2011-2015

Continue to monitor tortoises
Annual review with Conservation Mitigation Working Group

Appendix 2A. Field data sheet for use in the WEA

The following data sheet is to be used for tortoise encounters on this project.

LIVE TORTOISE TRANSMITTER DATA FORM

Fieldworker(s)________________
____
Fort Irwin, NTC Expansion
County San Bernardino State CA

Date (dd/mmm/yy)________________
Time : Start ________ End________
Temp. (2 cm above surface, °C)________
Photo: Digital ☐ Film ☐

Tortoise ID# ____________
WEA ☐ Sex __________
SEA ☐ Control ☐ Resident ☐
Translocation Site No. ________

TORTOISE LOCATION

At sheltersite: in tunnel ☐, at mouth ☐, on mound ☐, face in ☐, face out ☐, sideways ☐, unknown ☐

Not at sheltersite: in open ☐, under cover: ☐, of shrub ☐, of rock ☐, pallet ☐

nearby (dist-m) ________ m

ACTIVITY

Resting ☐, Basking ☐, Walking ☐, Feeding ☐, Digging ☐, Asleep ☐, Mating ☐, Combat ☐, Unknown ☐

TRANSMITTER

	NEW	OLD
Brand	______	______
Number	______	______
Freq.	______	______
Best Freq.	______	______

PURPOSE OF VISIT

Transmitter, Retransmitter, etc.
____
____

Transmitter Type
Round(Big) ☐ Single-Bat. ☐
Round(Med) ☐ Double-Bat. ☐
Round(Small) ☐ Juvenile ☐

VOIDING (All Encounters)

Urine: Amt. (ml) ______ Color (Circle) Clear Yellow Brown
Particulates: Amt. (ml) ______ Color (Circle) White Grey Pink

MEASUREMENTS/Shell Wear Class

MCL (mm)________ Mass (g)
Max. Height (mm)________ Initial ________
Max. Width (mm, at bridge) ________ Final ________

UTM (NAD 1983)
(Easting) ____________
(Northing) ____________

NARES (Circle) **YES NO UNK**
Signs of Disease ONLY
Nasal exudate dry/wet ☐ ☐ ☐
Exudate color ________
Rt/lLeft naris occluded ☐ ☐ ☐
Amt Occlusion %(Rt/Left) ____/____

FORELEGS
Dried exud. on scales ☐ ☐ ☐

EYES (Circle as needed)
Rt/Left Eye sunken ☐ ☐ ☐
Rt/Left Eye bulging ☐ ☐ ☐
Rt/Left Eye clear, bright ☐ ☐ ☐

EXTERNAL PARASITES:
Ticks ☐ ☐
Number ________
Ass. w/ Trans. Equip. ☐ ☐
Mites ☐ ☐
Number ________

SCUTE NUMBER ANOMALIES: ☐ ☐
Describe:________________

Epoxy Type(s) & Color:
Transmitter________________
Antenna________________

Other ID No.'s:________________

POSTURE/BEHAVIOR **YES NO UNK**
Appropriate for time of year ☐ ☐ ☐
Appropriate for time of day ☐ ☐ ☐
Alert, responsive ☐ ☐ ☐
Can withdraw tightly in shell ☐ ☐ ☐
Lethargic ☐ ☐ ☐
Limbs hanging loose ☐ ☐ ☐

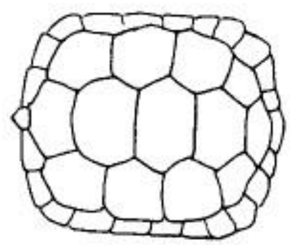
EVIDENCE OF SHELL DISEASE (Draw also)
Cutaneous dyskeratosis ☐ ☐ ☐
Surface area Carap/Plast/F-Limbs (%) ________
Fungal areas ☐ ☐ ☐

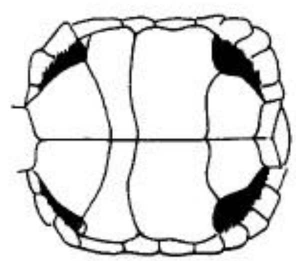
EVIDENCE OF TRAUMA TO: (draw also)
Head ☐ ☐ ☐
Forelimbs ☐ ☐ ☐
Hindlimbs ☐ ☐ ☐
Gular ☐ ☐ ☐
Carapace ☐ ☐ ☐
Marginals ☐ ☐ ☐
Plastron ☐ ☐ ☐
Type (predator, impact, etc.) ________
____

Notched This Encounter ☐ ☐
Gel-epoxy "Notch" ☐ ☐
(juveniles only)

LEGEND FOR DIAGRAM
Cutaneous dyskeratosis
Trauma
Note source, severity if active/healed/healing

DRAW TRANSMITTER, NOTCHES, & LABEL LOCATIONS





OTHER NOTES:________________________________
____

Version: May 4, 2008

Appendix 2B. Notching protocol for newly marked tortoises

Notching Protocol for Newly Marked Fort Irwin Tortoises
By A. Peter Woodman and William I. Boarman
September 11, 2007

All tortoises will be notched with the Highly-modified Honegger notching system (Fig. 3B-1; see below). The tortoise should be held firmly to the ground and the notches filed forcefully with a downward motion making sure that the animals head and legs are not in the path of the file strokes. All notches will be filed with a sharp, triangular file. Files will be replaced as they get dull or begin to rust (due to bleach used for disinfection). Notches will be filed deeply, but not so deeply as to scar the bone. The flat surface or "V" at the apex of the notch cut with a triangular file are diagnostic and will be more likely to be observable if deep. As much as possible, notches will be placed on the anterior or posterior portions of the scute to minimize impacts to the bone sutures. Locations of notches will be first marked with a felt pen or in a similar manner and double checked to help ensure that notches are made on the correct scutes.

A number of previous surveys have been conducted on the Southern Expansion and Translocation Areas and some tortoises have been notched using the Berry System. The notches used for the previous surveys were shallow nicks. All existing notches on relocated tortoises will be notched more deeply when part of the new tortoise ID number. Previous notches on scutes that do not need to be notched for the current effort will be left, but noted on the data form.

At the time of notching floy tags will be inspected to ensure they are legible. If not, they will be replaced with numbers printed on paper then epoxied onto the shell (fourth right costal) Epoxied and other numbers that are not legible will be replaced. Un-notched tortoises will be notched when they are re-transmittered, but not when they are translocated, since doing so may cause additional stress with unknown effects, potentially confounding interpretation of results.

One standard system for marking turtle shells was described by Rene Honegger (Marking amphibians and reptiles for future identification. International Zoo Yearbook 19:14-22; 1979) of the Zurich Zoological Garden and used widely throughout Europe. It apparently is a modification of a system developed by Froese and Burghart (A dense natural population of the common snapping turtle (*Chelydra s. serpentina*). Herpetologica 31:204-208; 1975). It uses the numbers 1, 2, 4, and 7 and marginals 1-4 and the last four marginals (Figure 1). At Fort Irwin, all tortoises will be marked using the following modification to the Honegger System (Fig. 1). The scute next to the supracaudal will be the number 1 (on right) and 10 (on left), the next one would by 2 (or 20), the third would be 4 and 40, and the fourth 7 and 70. This progression is somewhat more intuitive than the Honneger System and will likely reduce errors in notching and deciphering the code under field conditions. The four right front marginals will represent the hundreds (100, 200, 400, and 700), and the four left front marginals will represent the thousands (1000, 2000, 4000, 7000). In juvenile tortoises, the four bridge scutes (scute numbers 4, 5, 6, and 7, counted from the pygal scute, on right and left) will be avoided whenever possible. Hence, tortoise numbers in the 700, 800, 900, 1700, 1800, 1900, etc., and 7000, 8000, and 9000 series will be avoided whenever possible. To minimize confusion, tortoises will be marked and notched using the number series (FW5000-FW5999) within the WEA and number series (FW7000-

FW7999) within the WETA.

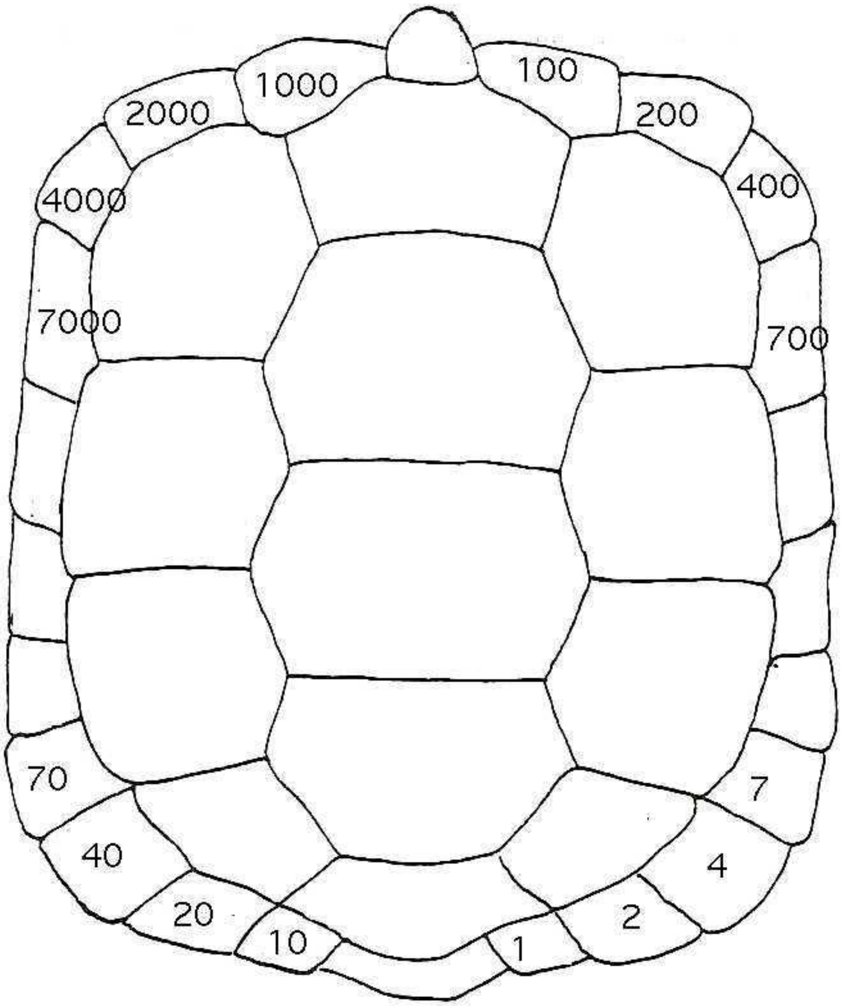


Figure 2B-1. Highly Modified Honegger System for marking desert tortoises at Fort Irwin, California.

Appendix 3. Health protocols for desert tortoises

Background

One goal of the Fort Irwin Translocation Project is to translocate healthy tortoises that have high potential to establish themselves at new sites. Tortoises that are debilitated from disease or previous traumas may be unsuitable for translocation. Protocols are already available to evaluate tortoises for general health and disease and to identify tortoises suitable for salvage (Berry and Christopher 2001). The protocol in this appendix is focused on evaluating and testing of tortoises for infectious diseases in the Western Expansion Area (WEA). Tortoises with infectious disease should not be translocated because they present a threat to naïve individuals and populations.

The most commonly known infectious diseases in wild desert tortoises are upper respiratory tract diseases (URTD) caused by *Mycoplasma* spp. and *Pasteurella* (Snipes and Biberstein 1982, Roberts et al. 2008). Some evidence exists for herpesvirus (Christopher et al. 2003, Johnson et al. 2006), but a strain from wild desert tortoises has yet to be isolated, characterized, and sequenced (Francesco Origgi, pers. comm.). There are other infectious diseases as well (Homer et al. 1998, Jacobson 1994, 2007).

No single test or clinical sign of disease is useful in determining whether a tortoise has or is capable of transmitting an infectious disease (e.g., Brown et al. 2002, Ritchie 2006). Enzyme-linked immunoassay (ELISA) tests for *Mycoplasma*, for example, may provide an indication of prior infection or of current anti-*Mycoplasma* antibody status, but they do not reveal whether a tortoise was shedding the bacteria at the time the blood sample was taken (Brown et al. 2002, Wendland et al. 2007). A recent study by Hunter et al. (2008) has found evidence of natural antibodies in tortoises to *M. agassizii*, indicating that caution should be applied in interpreting ELISA-positive results because these tortoises may not have been previously exposed but simply carry natural immunity that can only be distinguished from acquired immunity through the use of western blots. *Mycoplasma* species can be cultured by taking oral swabs and nasal lavages, but are generally very difficult to grow. Once cultured, they can be identified by polymerase chain reaction (PCR) tests. Thus a combination of clinical signs, ELISA and PCR tests, western blots, and cultures can be useful in diagnoses. Herpesvirus presents similar problems: many strains exist and others need to be identified (e.g., Origgi et al. 2004, Ritchie 2006, Martel et al. 2009). For some herpesviruses, ELISA and serum neutralization tests are used for antibody detection and may be available; diagnostic testing can include PCR tests, biopsies, identification of virus particles with electron microscopy, cell cultures, and several other techniques (e.g., Origgi et al. 2004, Ritchie 2006). In summary, even though we prescribe all known assays (i.e. those with at least 1 published and positive validation of their efficacy) in this plan, it is possible that the generality of the ELISA tests and the specificity of the PCR testing in combination with clinical observations may present us with information that individual tortoises are not well, but specific diagnoses of what disease is present are not possible with the tools available now.

Tortoises with an infectious URTD caused by mycoplasmosis or herpesvirus may have a nasal discharge (Jacobson et al. 1991, Brown et al. 1994, Schumacher et al. 1997, Ritchie 2006). When the nasal discharge is present, the tortoises may be more likely to transmit pathogens to other tortoises. For example, in early studies of *M. agassizii* in desert tortoises, the relationship between clinical signs of URTD and the ELISA test for *M. agassizii* was evaluated by Schumacher et al. (1997). Ninety-three percent of tortoises with mucous nasal discharge tested seropositive, and the presence of nasal discharge was highly predictive for exposure to *M. agassizii*. In transmission experiments, naïve tortoises were infected with *M. agassizii* by using the nasal discharge (Brown et al. 1994).

Tortoises can have subclinical disease or latent infections. They may have no clinical signs and be shedding bacteria or viruses (Schumacher et al. 1997, Ritchie 2006, Martels et al. 2009). For example, the ELISA test for *M. agassizii* also detected potential subclinical infections in 34% of tortoises without clinical signs of disease (but see Hunter et al. 2008). Less is known about the relationship between clinical signs for tortoises with *M. testudineum* or herpesvirus, ELISA and PCR tests, and cultures. Veterinarians recommend that tortoises surviving herpesvirus infections be kept isolated from other tortoises and not translocated because they are still capable of infecting other individuals (Ritchie 2006, Martels et al. 2009).

When tortoises with positive serological tests for either *M. agassizii* or *M. testudineum* or both species were necropsied, they were found to have mild to severe lesions in the nasal cavities (Jacobson et al. 1995, Homer et al. 1998, Jacobson and Berry 2009). Tortoises without clinical signs of URTD may have negative serology for *M. agassizii* but may have lesions in the nasal cavities; these tortoises may have subclinical disease (Jacobson et al. 1995). We do not have similar information for *M. testudineum.* We do not know the frequency or prevalence of tortoises with negative ELISA tests and lesions in the nasal cavities typical of mycoplasmosis in a population.

Field Protocols for Health Evaluation

This health evaluation protocol has been designed to identify tortoises with clinical and subclinical infectious diseases and to remove such tortoises from the translocation program. These actions are essential to safeguard both the recipient population from exposure to potentially infectious diseases, as well as the translocated individuals. The following procedures are illustrated in Figure A3-1, and the numbers that accompany each part of the procedure in the following paragraphs are used to label the procedure (Figure A3-1).

The first step (1, Fig. A3-1) is to identify tortoises with clinical signs of disease, particularly infectious diseases that would render them unsuitable for translocation using the standard health evaluation form (Berry and Christopher 2001, modified appendix). For the purposes of this translocation project, clinical signs of acute infection are defined for URTD as nasal or moderate-to-severe ocular discharge (U.S. Fish and Wildlife Service 2008 [Appendix B], Berry and Christopher 2001). Clinical signs of a previous or dried nasal discharge include eroded nares or partially or completely occluded nares. Clinical signs of dried ocular discharge can be manifested as crusts and dried mucus on the palpebrae, periocular area, fornix, and beak. Signs of dried nasal and ocular discharge must be obvious and should not be confused with dried dirt or mud on the beak and nares from recent rain events. For herpesvirus, typical clinical signs are plaques on the tongue, palate, and other parts of the mouth (Origgi et al. 2004, Ritchie 2006). Emaciated or moribund tortoises should be salvaged for necropsy.

A subcarapacial or brachial blood sample will be taken (Hernandez-Divers et al. 2002) with special attention given to avoiding lymph in the sample and dilution. Notations shall be made on the data sheet about potential presence of lymph in the sample, and where necessary, sampling may need to be repeated. For small and large adult tortoises >180mm CL, up to 2 ml may be collected. Tortoises <100mm may have <5% of total body weight drawn in blood samples (ASIH 2004). The protocol provided by Dr. L. Wendland, based on the following equation with estimates in Table 1, is useful:

Maximum blood draw (ml) = Body Weight of tortoise to be bled (kg) * 1000 g/kg * estimated 6% blood volume * 10%

Table 1. Amounts of blood that may be drawn from small tortoises by carapace length at the midline (mm, MCL).

Size of tortoise (mm, MCL)	Amount of blood to be drawn (ml)
< 80*	0.15–0.25, with the upper level more desirable. For the 45 g tortoise, the lower number must be used.
80–100	0.5–0.6
>100–140	0.6–1.0
>140–179	>1.0–2.0

The mouth will be examined by a person trained in identifying the clinical signs of herpesvirus infections and may be swabbed for use in analyses of potential herpesvirus infection research (University of Florida-Small Animal Clinical Sciences 2009). If the tortoise has no acute clinical signs of infectious disease, a radio transmitter shall be attached, and the tortoise shall be released *in situ* (Step 2, Fig. A3-1). Tortoises with acute clinical signs of infectious disease (Step 7, Fig. A3-1) will be removed from the field after the health evaluation is completed, a blood sample is collected (Hernandez-Divers et al. 2002), a swab of the mouth taken, and a nasal lavage is conducted for cultures and a PCR test for *Mycoplasma* spp. (Brown et al. 2002). These tortoises will be taken to previously established quarantine facility at the southeast corner of the Western Expansion Area, where they will be maintained as 1 tortoise per individual isolated compartment (suggested size $\geq 100\ m^2$) while the laboratory samples are being analyzed.

Juvenile tortoises encountered will be processed in the same manner as adult tortoises, with the same protocol. However, all animals too small to receive an 11- or 12-month transmitter will be removed from the field and transported to a temporary outdoor holding facility. The holding facility will be maintained according to all legal and ethical requirements for treatment of captive animals (e.g., Animal Care and Use Guidelines from ASIH 2004).

Management of Blood Samples in the Field and in USGS Labs

Blood samples will be immediately placed on ice and centrifuged within 4 hours of sampling. After centrifuging, plasma will be separated from the red blood cells and stored in liquid nitrogen, dry ice, or in a freezer until samples are shipped to a reputable laboratory for testing. The plasma samples sent to the lab should contain a minimum lymph (<10%) to minimize the potential for dilution and a false negative test. Red blood cells that are a by-product of the centrifuging process will be stored for potential future genetic analyses. Nasal lavage sample will also be chilled immediately and fast frozen on dry ice or in a freezer within 4 hours of collection. A separate protocol shall be developed for swabs of the mouth for testing herpesvirus. Where and how this protocol is to be developed is under consideration (K. Berry – *personal communication*.

Laboratory Testing

Blood samples from both groups of tortoises (acute clinical signs vs. no acute clinical signs) will be submitted to a qualified laboratory for testing. For all tortoises, the tests shall include ELISA tests for *M. agassizii* and *M. testudineum;* Western Blot for *M. agassizii;* and available ELISA, serum neutralization and other appropriate tests for herpesvirus. For tortoises with acute clinical signs, cultures and PCR will be undertaken for *Mycoplasma* spp.

Disposition of Tortoises After Laboratory Results Are Available

For the group of tortoises with no acute clinical signs: if all lab tests are negative (Step 3, Fig. A3-1), the tortoise will be translocated (Step 4, Fig. A3-1). If any test is positive (Step 5, Fig. A3-1), then the tortoise will be moved to the quarantine facilities (Step 6, Fig. A3-1), retested and re-evaluated at 6-week intervals until the health status is clarified. Upon re-test, ELISA-positive individuals showing innate-immunity banding patterns with the western blot will be translocated and included in the monitoring program. If a tortoise has a suspect test while remaining in the WEA, it will also be retested and re-evaluated at 6-week intervals until a definitive test result is confirmed. It will not be moved to quarantine unless additional tests are positive or it shows acute clinical signs of infectious disease.

For the group of tortoises with acute clinical signs: if all lab tests are negative (Step 9, Fig. A3-1), the tortoise will be re-tested and re-evaluated after a 6-week interval to double-check test results (Step 8, Fig. A3-1). If any test is positive (Step 5, Fig. A3-1), then the tortoise will remain in the quarantine facilities (Step 6, Fig. A3-1) and a decision made for further disposition (Steps 10-12, Fig. A3-1). If the tortoise has suspect test(s), it will also be retested and re-evaluated after a 6-week interval and will be maintained in quarantine (Step 6, Fig. A3-1). If all disease tests are negative (Step 9, Fig. A3-1) and the tortoise still has acute clinical signs of disease, it will be designated for necropsy (research) to determine the source of disease. Such animals may have an infectious disease, but the protocol for disease testing may be insufficient to identify the pathogen. Those tortoises with no acute clinical signs (after the initial observation) and negative tests, may be returned to the WEA (Step 10, Fig.A3-1) after the translocation has been completed. The potential release locations for these animals will take into consideration their original home-range, low intensity military training zones, other appropriate habitat, as well as proximity to roads and property boundaries.

Tortoises may be maintained in quarantine for up to 6 months after the WETA is cleared in its entirety (Step 6, Fig. A3-1), at which time a decision must be made to include them in a research program (Step 11, Fig. A3-1), incorporate them into headstart or breeding programs (Step 12, Fig. A3-1), or returned to the WEA (Step 10, Fig. A3-1). Only tortoises that are moribund or that show acute clinical signs of disease but all diagnostic tests are negative will be euthanized (Step 13, Fig. A3-1). Tortoises returned to the WEA may be important for future research. Tortoises found in the WEA after translocation has been completed and during future Army training activities will be removed from immediate danger and remain in the WEA.

Risks Associated with Translocation

In contrast to the SEA phase of the translocation, in which attempts to minimize the risk of disease transmission were made by excluding plots of concentrated seropositive individuals from the research-release plots, the WEA phase of the translocation is not employing a plot-based research or monitoring program. Here, risk of disease transmission is minimized by buffering seropositive or clinically ill tortoises so that translocated individuals are less likely to come into contact with them. However, there are limitations to this approach because tests are not available for all previously identified or suspected diseases. We recognize that health data from a single field evaluation and a single blood sample for a tortoise are for the date of collection only. The tortoise may have been exposed to mycoplasmosis or herpesvirus prior to the field evaluation, be in the process of developing antibodies, and may later break with disease. How soon after exposure will a tortoise have positive serology for *M. agassizii* or *M. testudineum*? For *M. agassizii*, Brown et al. (1994) reported a significant rise in the antibody titer as early as one month after postchallenge and also after 3 months. We don't have an answer to this question for *M. testudineum* and will not have an answer until the test is validated with experimental infections. We have even more limited information for herpesvirus infections.

If the tortoise is not isolated from other tortoises between the time it is first evaluated in the field and a determination is made that it is *Mycoplasma*-free, it may have contact with an infected tortoise and subsequently become infected. Thus, there is a risk of translocating a tortoise that appears to be healthy (negative for all tests and clinical signs) but has recently become infected. The risk probably increases depending on the proximity of the healthy, tested tortoise to a *Mycoplasma*-infected or herpesvirus-infected tortoise. Results of *Mycoplasma* testing in the SEA and WEA between 2005 and 2008 indicate that frequency of tortoises with positive ELISA tests is <5%. Removing individuals showing acute clinical signs of disease at the first opportunity minimizes (but does not eliminate) risks of those individuals infecting susceptible tortoises in the WEA while diagnostic tests are being conducted in the lab.

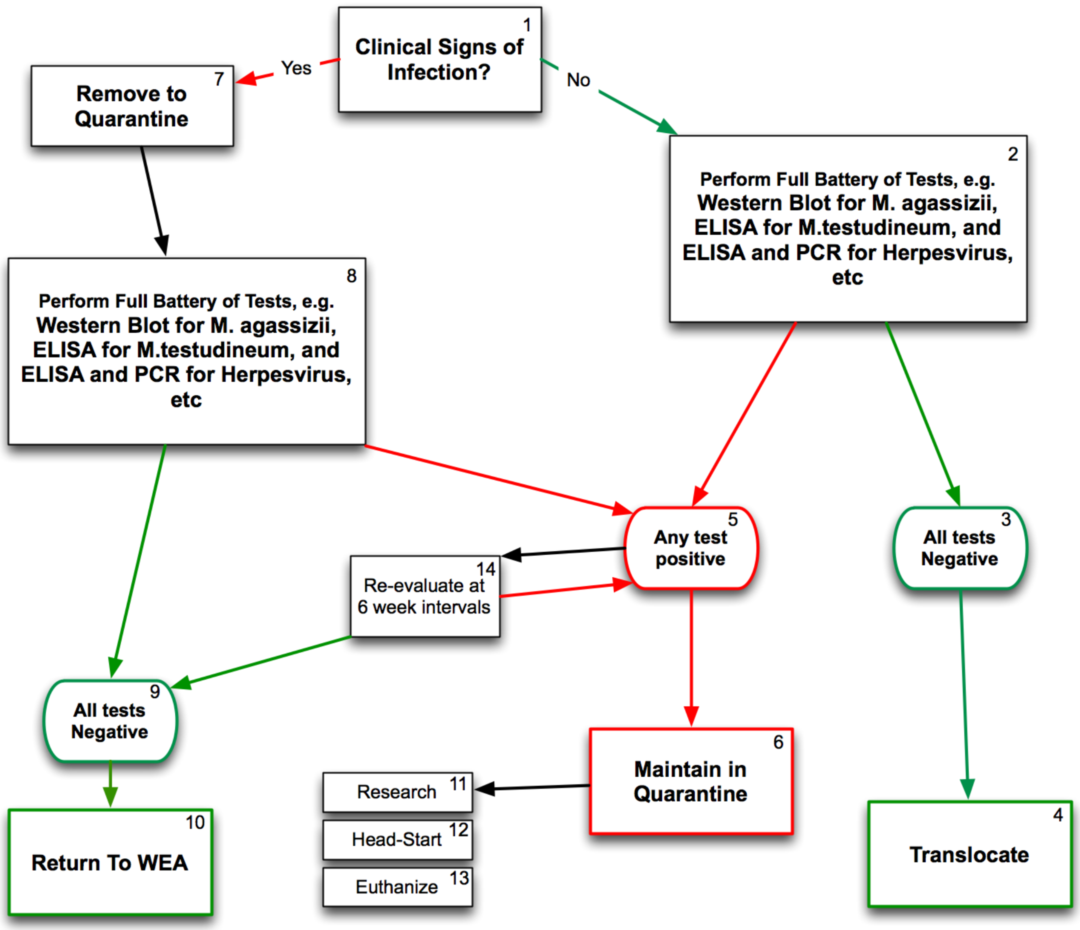


Figure A3-1. Decision tree for health assessment of desert tortoises at Fort Irwin, California.

NOTE: Step 9. If the tests are negative but the tortoise still has a nasal discharge, it should be necropsied (put into Step 11) to determine what disease it has. It may be a tortoise with a new herpesvirus or *Pasteurella*.

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Appendix 4. Translocation site selection decision support model

Methods

Because analysis procedures and the technological framework were identical much of the following text was taken directly from Heaton et al. (2008). The study area is new and in some cases model criteria, data, and model parameterization were changed. These differences are noted below.

Study Area

The area for prospective translocation covered 1,153.6 km^2 to the southwest of the National Training Center at Fort Irwin (NTC) in southern California, USA, including portions of one desert tortoise Critical Habitat Unit — Superior-Cronese. The study area was subdivided into 2.59 km^2 cells that served as units of analysis. The area of each cell was equivalent to one U.S. Public Land Survey System section, typically referred to in statutory units of 1 mi^2. This unit size was chosen at the request of the decision makers for the purpose of identifying Public Land Survey System sections that could be purchased to fulfill the land acquisition mitigation measure. We scaled all data sets to this cell size.

Technological Framework

The criteria, relationships between criteria, and criteria weights used to evaluate the translocation potential of a site were documented in NetWeaver (Saunders et al. 2005). Using fuzzy logic (Zadeh 1968), we parameterized these criteria, assigning them truth values which ranged from -1 to 1, where 1 was considered completely suitable, and -1 completely unsuitable. The fuzzy logic framework accommodates uncertainty commonly lost in ecological modeling under traditional mathematical models (Openshaw 1996; Reynolds 2001). For example, species distributional limits may be gradual rather than abrupt, or knowledge of these precise limits may be incomplete (Meesters et al. 1998). For this model, each section was assigned a truth value related to the degree to which that section was predicted to be suitable for translocation given the combined suitability of all the criteria at that location.

We pre-processed all data for developing criteria using ESRI ArcGIS 9.2 and the third party products ETGeoWizard and Hawths Tools. Spatial models for each criterion and all criteria combined were run within the Ecosystem Management Decision Support (EMDS; Reynolds 2001) ArcGIS extension. Ecosystem Management Decision Support provides a framework for open and spatially explicit decision support modeling in ecological investigations at multiple geographic scales (Reynolds et al. 1996, 2003; Reynolds and Hessburg 2005).

Model Criteria

Criteria Selection

The criteria selected for prioritizing potential translocation sites included biological and anthropogenic factors affecting desert tortoise populations in the Western Mojave Desert Recovery Unit. Seven criteria were selected for assessing translocation suitability. The following base scenario was developed as follows.

Ownership
Because extensive tracts of federal lands suitable for translocation existed within the study area, sections that contained privately held lands or state lands were considered unsuitable. Only complete U.S. Bureau of Land Management sections and complete sections recently purchased by the NTC as mitigation were considered suitable. Thus this criterion was binary, either suitable (1.0) or unsuitable (-1.0).

Habitat
Since the previous translocation effort surrounding the expansion of the NTC (Esque et al. 2005; Heaton et al. 2008) a desert tortoise habitat model has been developed (Nussear et al. *In Review*). This model was used for ranking habitat suitability within each section. The 1 km^2 cell size habitat model was converted to the 2.59 km^2 analysis cell size using area weighted average. As the model values are not linearly related (i.e. 1.00 is not twice as good as 0.50) we developed a non-linear curve (Figure A4-1).

Proximity to Major Unfenced Roads and Highways
Tortoises are known to displace up to 15 km after translocation (Berry 1986; Nussear 2004), and evidence of tortoise presence is reduced up to 4 km from major roads (Von Seckendorff Hoff and Marlow 2002; Boarman and Sazaki 2006). Since major roads can be a source of mortality, act as barriers, or at least filter tortoise movement (Gibbs and Shriver 2002; Von Seckendorff Hoff and Marlow 2002), areas <15 km from major roads and highways were considered unsuitable and areas >15 km suitable (Figure A4-2).

Proximity to Urban Areas
Urban areas are considered poor habitat; thus, translocation suitability increases with distance from such areas. This criterion was parameterized identical to proximity to major unfenced roads and highways based upon the same knowledge regarding tortoise movement most translocation (Figure A4-2).

Road Density
Within the Mojave Desert, paved and dirt roads have been implicated in the spread of non-native plant species, increased risk of fire, compaction and increased erosion or soils (Brooks 1999; Brooks and Pyke 2001; Brooks and Lair 2009; Lei 2009). Moreover, roads are known to negatively impact small mammal, lizard, and tortoise populations and habitat (Busack and Bury 1974; Brattstrom and Bondello 1983; Bury and Luckenbach 2002; Von Seckendorff Hoff and Marlow 2002; Boarman and Sazaki 2006), destroy native biological soil crust important for soil stability (Belnap and Eldridge 2001; Belnap 2002), and facilitate human access (Trombulak and Frissell 2000). Unfortunately, access is accompanied by illegal activities such as releasing captive tortoises, collecting, shooting, harassing, etc. The deleterious effects of the increase in roads on tortoise populations have not been explicitly quantified; however, more roads presumably pose a greater level of threat to tortoises. Road density was calculated as the total km of paved and unpaved roads per section; most roads were unpaved. Areas with more roads were considered less suitable than those with fewer roads (Figure A4-2). The data for this criterion were identical to that utilized in Heaton et al. (2008) however the parameterization was updated to match the statistical range of the data within the new study area.

Depleted Regions
The ratio of live to carcass encounter rate was calculated for each analysis cell; cells in which carcass encounter rate exceeded live encounter rate were identified as die-off regions. Observation data were obtained from U.S. Fish and Wildlife Service monitoring data (2001-2005, 2007-2008).

Die-Off Good
Parameterization was categorical; areas with more carcasses were assigned a truth value of +1; areas with equal numbers of live and carcass observations were assigned a truth value of 0.0; areas with more live observations were assigned a truth value of -1.0; and areas with no sample transects were assigned a truth value of undetermined.

Utility Corridors
Translocating tortoises to areas already developed as or slated for utility corridor development would be counterproductive to recovery goals, posing significant future management challenges. Areas within utility corridors were considered unsuitable (-1.0), areas adjacent to these corridors were considered somewhat more suitable, but still relatively unsuitable (-0.5), and areas outside and not adjacent to utility corridors were considered suitable (1.0).

Additional Factors Considered
Although additional biological and anthropogenic factors potentially affecting tortoise populations were considered, they were not modeled separately from the habitat model in this exercise for the following reasons: (1) little or no potential influence in the study area (e.g., latitude and elevation), (2) no suitable spatial data for modeling existed, and efforts required to secure them were time or cost prohibitive (e.g., raven distribution, nutritional composition and distribution of forage grazing and soil friability), or (3) the spatial resolution of the data were insufficient for detecting meaningful variability (e.g., precipitation). Several criteria modeled in Heaton et al. (2008) were not considered here. Proximity to the NTC was used as a surrogate for genetic information in the original translocation plan, but genetics were taken into account for the WEA translocation when the study area was selected (K. Berry, *pers comm*). There were no Off-Highway Vehicle areas in or any Projected Urban Growth areas within 15 km of the current translocation area.

There has been some interest and general discussion about the condition of vegetation in the translocation areas and whether or not the condition of the vegetation at any particular point in time is a good indicator of the value of the habitat (CMWG meeting minutes). Conditions describing the value of habitat related strictly to the abundance of vegetation on a landscape scale have not been addressed quantitatively in the literature, to date. It is fair to say that areas with extremely sparse perennial shrubs (e.g. <8 % cover) over large expanses provide very low or highly variable annual primary production on average. In contrast, areas where the vegetation of perennial shrubs is at least 15% cover (e.g., *Larrea tridentata* and *Ambrosia dumosa* association) are likely to have sufficient long-term average production to support desert tortoises (T. Esque – personal observation). However, any snap-shot of the condition of perennial shrubs or annual vegetation at such a site may be a poor indicator of the potential for that site due to inter-annual variation in precipitation. Tortoise populations regularly experience years of very low precipitation which affects their hydration status (Nagy and Medica 1986) as well as the condition of local plant populations, but individual years or even 2 years in succession are usually not sufficient to create population-level problems for desert tortoises.

Relative Weighting of Criteria

Criteria were arranged in a logical structure and ranked by level of importance for translocation. The criteria were assigned to one of two tiers with each criterion equally weighted. The first tier criteria (ownership, habitat, proximity to urban areas, and proximity to major roads and highways), were regarded as the most influential, such that if any one of the parameters were unsuitable that section was considered unsuitable for translocation. The second tier criteria were road density, die-off ranking, and utility corridors. Model scores for the second tier criteria were averaged such that no single criterion rendered a section unsuitable for translocation. However, their combined effect could influence the model. All first and second tier criteria were combined to create a translocation suitability value for each section.

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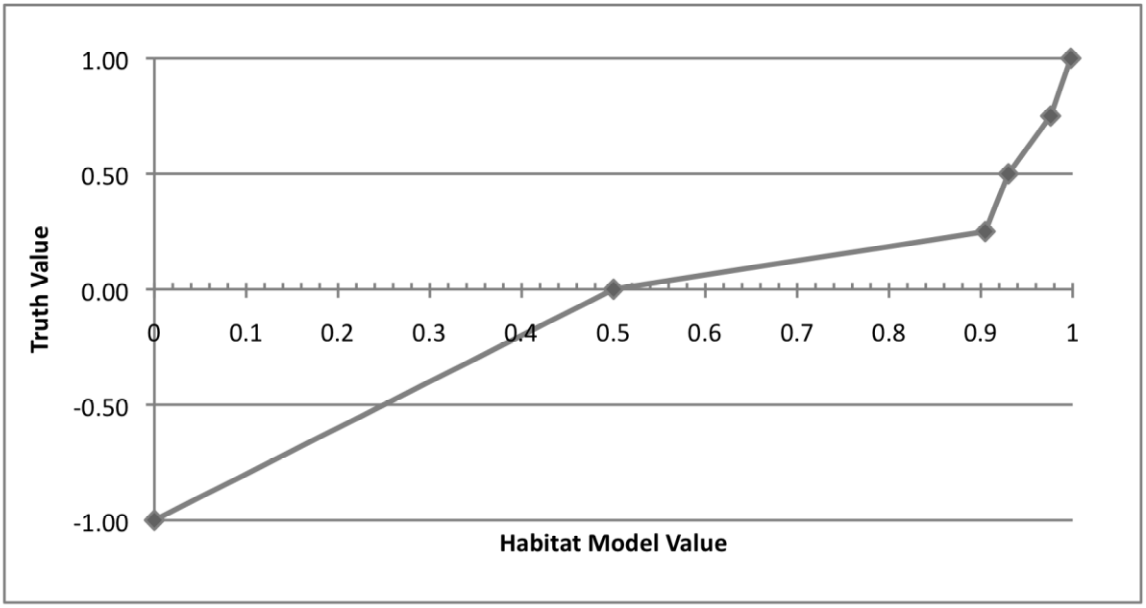

Figure A4-1. Habitat criterion truth value rankings. The highest habitat model value is 0.998.

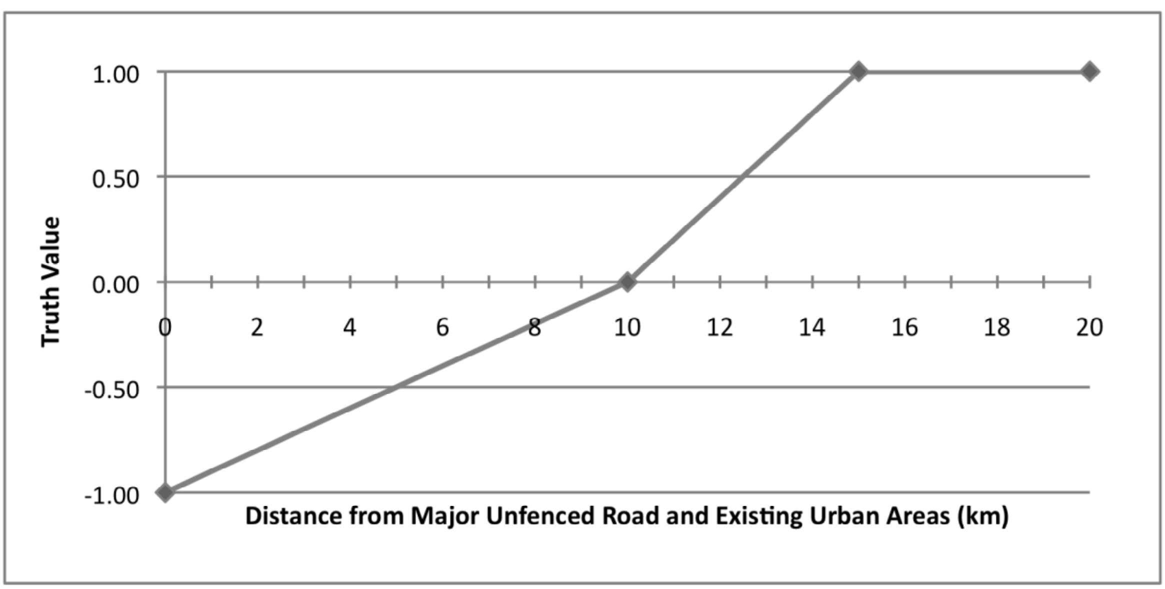

Figure A4-2. Distance from major unfenced road and existing urban areas truth value rankings.

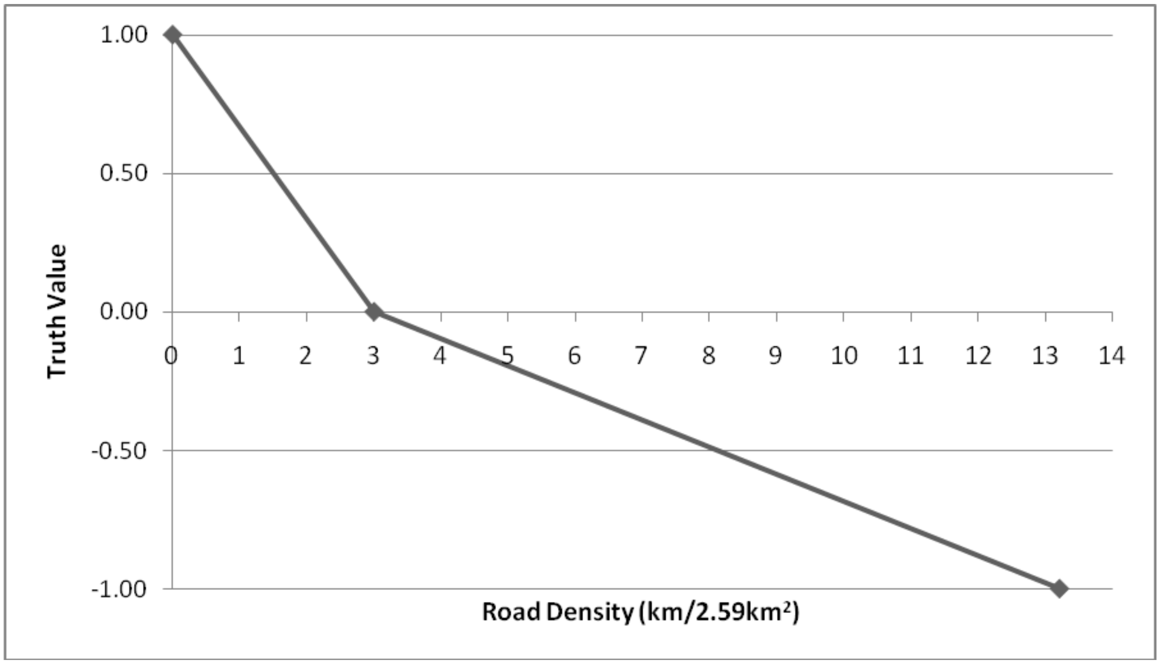

Figure A4-3. Road density truth value rankings.

EXHIBIT 450

Calico Solar Desert Tortoise Translocation Plan Recipient Site Photographs, Spring 2010

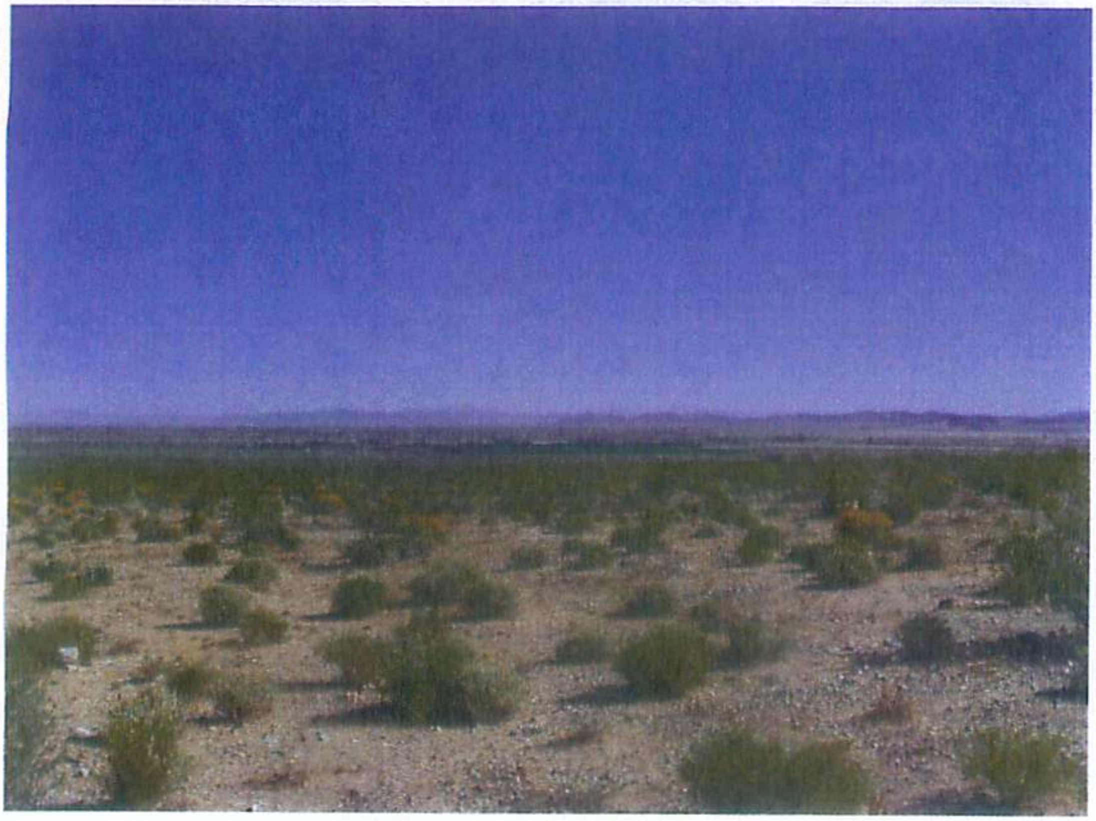	**Photograph # 4** **Date: Spring 2010** **Comments:** Long Distance DWMA Translocation Area

EXHIBIT 451

Draft Decision Tree for Short-distance Translocation of Desert Tortoises

Defining short-distance translocation

Short-distance translocations can be defined according to sex and size/age class of the tortoise, distance from the home site (single point, where last found), and habitat type of the home site and release area. A short-distance translocation is determined by the straight line distance from the site where the tortoise was collected to the site where it was or will be released. Presumably a tortoise-proof fence separates or will separate the home site from the release area. One key issue (and assumption) is home range size. For a short-distance translocation, the project proponent or government assumes that the release site will be within or in close proximity to the edge of the original home range of the translocatee. A corollary to this assumption is that the translocatee will be more likely to settle and remain where it has been placed because part of its home range is close to or within the release area. There are problems with such assumptions, especially in providing a single distance figure for defining short-distance translocation. Home range sizes may vary from place to place and may be dependent on available resources (food, cover sites, mates), sex, size class, social status, and quality of habitat (surficial geology, soil composition, etc.). Another topic is infectious disease (especially mycoplasmosis) which will be discussed in another section.

One research project which is part of the Ft. Irwin Translocation Project is focused on short-distance translocation. This project was initiated in 2008 and will continue for a few years. Tortoises living inside the fenced boundary of Ft. Irwin and within 400 m of the Ft. Irwin fence were translocated across the fence onto public land approximately 100 to 200 m from the fence (William Boarman, personal communication). Dr. Boarman does not have statistics available at this time on mean distances the tortoises were translocated. The greatest distance a single tortoise would have been translocated was 600 m.

Dr. Boarman's team calculated distances that tortoises moved after translocation (Walde et al. 2009) for the 2008 Annual Report for the Ft. Irwin Translocation Project. In the report are tables displaying mean distances (and ranges) moved by juvenile, immature, adult male, and adult female tortoises for long-distance hard releases (3 sites, all sizes of tortoises), long-distance soft releases (3 sites), short-distance translocations, and control and resident tortoises (4 sites). The distances are single vector distances, representing the greatest distance a tortoise moved in 10 months, between the time the tortoises were translocated in March/April of 2008 and January of 2009.

For short-distance translocations, data are available for adult female and adult male tortoises for three groups: translocatees, residents, and controls (Table 1). Residents are defined as tortoises already living within the study area where the translocated tortoises were placed; control tortoises were outside but nearby the study area and were not affected by the presence of translocatees. Adult females in the translocatee and control groups appear to move shorter distances than adult males, whereas there was little difference between the adult sexes for resident tortoises. When the movements of adult male and female tortoises in the short-distance translocation experiment are compared with similar data for translocatee tortoises at three hard release, long-distance sites, on average, males and females at the three hard release sites moved 4.2 and 5.1 times greater distances, respectively, than the short-distance translocatees (calculated from data provided by William Boarman, personal communication).

Table 1. Mean and range of straight-line distances moved in the first 10 months after translocation for short-distance translocatee, resident, and control tortoises (Boarman et al. 2009). Only the resident and control tortoises associated with the short distance translocation were included below.

Sex	Mean of straight-line distance moved and (range) in meters		
	Short-distance translocatees	Control	Resident
Adult female	298 (73-589)	117 (69-175)	240 (11-925)
Adult male	619 (116-1473)	337 (41-691)	297 (3-654)

When the data for the control and resident tortoises are evaluated for all of the release sites (Walde et al. 2009, summary of data provided by W. Boarman), it is obvious that there are site differences in the distances moved after translocation by tortoise size and sex. The differences in sites may be related to habitat quality, but that remains to be determined.

The data from Ft. Irwin's Southern Expansion Area (SEA) on short-distance translocation can be used to estimate the maximum distances that tortoises should be moved for this type of translocation (Table 1). Drawing from Table 1 and emphasizing the mean distances moved by control and resident tortoises, adult males and females should be translocated within 340 and 250 m of their home sites, respectively. These figures could change when calculations become available for the mean and range of distances the tortoises were translocated for the short-distance translocation. These distances could differ if a mean is used for multiple habitat types. For example, the mean distances moved by adult male tortoises in the control group for 3 study sites in the long-distance translocations ranged from 389 to 1597 m (average 612 m). The three sites varied considerably in habitat characteristics.

Mycoplasmosis and Other Infectious Diseases

An important consideration in translocating tortoises is the potential presence of infectious diseases in the animals to be translocated, as well as in the resident population where the tortoises are anticipated to be released. One might assume that disease is unlikely to be an issue for short-distance translocation, because the distance is so short and tortoises would be interacting with each other. One might further assume that evaluating the tortoises for health and testing them for diseases is unnecessary. That assumption depends on the size of the project, the maximum distance the translocatees are to be moved, their home range sizes in the specific area, density of tortoises, geographic boundaries, boundaries of anthropogenic activities, and the incidence and distribution of infectious disease. These points can be illustrated in part by reviewing the 2007-2008 data sets for mycoplasmosis for Ft. Irwin's SEA (e.g., Berry et al. 2008, 2009). While the prevalence of *Mycoplasma testudineum* and *M. agassizii* in tortoises was low in the entire SEA, tortoises with *M. testudineum* were clustered near the Manix Trail at the southern boundary on the National Training Center. Without intensive sampling, we would not have known about the cluster of tortoises with positive samples. The southern boundary extended for >20 km. Tortoises could have been translocated using short-distance translocation over much of the southern boundary and the hot spot could have been avoided.

Some potential short-distance translocations deal with projects involving a few hectares and a few tortoises. Such projects are less likely to have hot spots of tortoises with disease. However, that being said, translocating a tortoise with an infectious disease, even a short distance, is likely to be unwise. We have little information on how far infectious tortoises might travel and how many tortoises the infected individual might contact. Tortoises that are translocated short distances can move >1400 m in 10 months (see Table 1). For that reason, we need to conduct research on effects of health and disease on tortoises involved in or affected by short-distance translocations. Such a project has not been undertaken.

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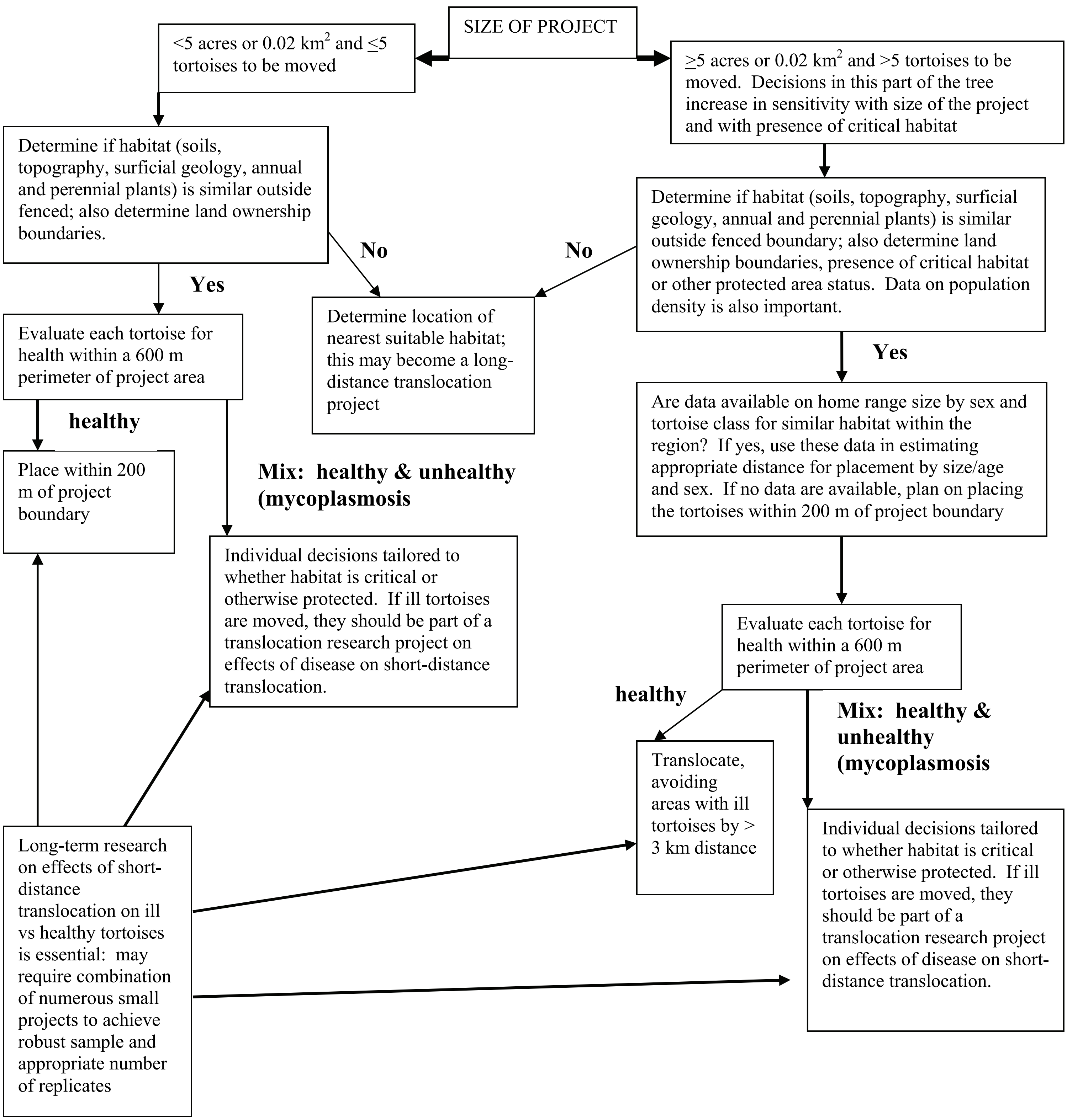
SIZE OF PROJECT
<5 acres or 0.02 km^2 and ≤5 tortoises to be moved
≥5 acres or 0.02 km^2 and >5 tortoises to be moved. Decisions in this part of the tree increase in sensitivity with size of the project and with presence of critical habitat
Determine if habitat (soils, topography, surficial geology, annual and perennial plants) is similar outside fenced; also determine land ownership boundaries.
No
No
Determine if habitat (soils, topography, surficial geology, annual and perennial plants) is similar outside fenced boundary; also determine land ownership boundaries, presence of critical habitat or other protected area status. Data on population density is also important.
Yes
Evaluate each tortoise for health within a 600 m perimeter of project area
Determine location of nearest suitable habitat; this may become a long-distance translocation project
Yes
Are data available on home range size by sex and tortoise class for similar habitat within the region? If yes, use these data in estimating appropriate distance for placement by size/age and sex. If no data are available, plan on placing the tortoises within 200 m of project boundary
healthy
Place within 200 m of project boundary
Mix: healthy & unhealthy (mycoplasmosis
Individual decisions tailored to whether habitat is critical or otherwise protected. If ill tortoises are moved, they should be part of a translocation research project on effects of disease on short-distance translocation.
Evaluate each tortoise for health within a 600 m perimeter of project area
healthy
Mix: healthy & unhealthy (mycoplasmosis
Translocate, avoiding areas with ill tortoises by > 3 km distance
Long-term research on effects of short-distance translocation on ill vs healthy tortoises is essential: may require combination of numerous small projects to achieve robust sample and appropriate number of replicates
Individual decisions tailored to whether habitat is critical or otherwise protected. If ill tortoises are moved, they should be part of a translocation research project on effects of disease on short-distance translocation.

EXHIBIT 452

Control Treatment. A control treatment is needed in some experiments, but not in all. A control treatment consists of applying the identical procedures to experimental units that are used with the other treatments, except for the effects under investigation. In a study of food additives, for instance, a treatment may consist of a portion of a vegetable containing a particular additive that is served to a consumer in a particular experimental setting in the laboratory. A control treatment here would consist of a portion of the same vegetable served to a consumer in the identical experimental setting except that no food additive has been used.

A control treatment is required when the general effectiveness of the treatments under study is not known, or when the general effectiveness of the treatments is known but is not consistent under all conditions. In the food additives example, suppose it is known that food additive A is highly effective in enhancing the tastiness of vegetables and it is desired to see if additives B and C are equally effective or possibly even more effective. In that case, a standard of comparison is available and no control treatment is required. On the other hand, suppose there is no knowledge about the general effectiveness of the three additives, and the following results are obtained (ratings can range between 0 and 60):

Additive	*Mean Rating*
A	39
B	37
C	41

Assume that the sample sizes are large so that the mean ratings are very precise. In the absence of a standard of comparison, one would not know here whether each of the three additives is effective or whether none of the additives is effective.

It is crucial that the control treatment be conducted in the identical experimental setting as the other treatments. In the food additives example, for instance, a survey of consumers at home, in which persons are asked to rate the general tastiness of the vegetable (without any additive) on the same scale as in the experiment, would not qualify as a control treatment. Such a survey might yield a mean rating of 22, suggesting that the three additives substantially increase the tastiness of the vegetable. This conclusion, however, could be grossly misleading. If the control treatment actually were incorporated into the experiment so that consumers are given portions of the vegetable with no additive in the laboratory setting, the mean rating for the control treatment might be 40. This result would imply that none of the three additives is effective in enhancing the tastiness of the vegetable. The reason for the higher mean rating in the laboratory setting could be a "halo" effect connected with the experimental procedures. Possibly, foods served in the experimental setting taste better than at home, or perhaps consumers try to oblige by giving higher ratings when they participate in an experimental study. Thus, only a control treatment incorporated into the experiment can serve as the proper standard of comparison.

EXHIBIT 453

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GUIDELINES FOR THE FIELD EVALUATION OF DESERT TORTOISE HEALTH AND DISEASE

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ABSTRACT: Field evaluation of free-ranging wildlife requires the systematic documentation of a variety of environmental conditions and individual parameters of health and disease, particularly in the case of rare or endangered species. In addition, defined criteria are needed for the humane salvage of ill or dying animals. The purpose of this paper is to describe, in detail, the preparation, procedures, and protocols we developed and tested for the field evaluation of wild desert tortoises (*Gopherus agassizii*). These guidelines describe: preparations for the field, including developing familiarity with tortoise behavior and ecology, and preparation of standardized data sheets; journal notes to document background data on weather conditions, temperature, rainfall, locality, and historic and recent human activities; procedures to prevent the spread of disease and parasites; data sheets for live tortoises to record tortoise identification, location, sex, body measurements and activity; health profile forms for documenting and grading physical abnormalities of tortoise posture and movements, general condition (e.g., lethargy, cachexia), external parasites, and clinical abnormalities associated with shell and upper respiratory diseases; permanent photographic records for the retrospective analysis of progression and regression of upper respiratory and eye diseases, analysis of shell lesions and evaluation of growth and age; and indications and methods for salvaging ill or dying tortoises for necropsy evaluation. These guidelines, tested on 5,000 to 20,000 tortoises over a 10 to 27 yr period, were designed to maximize acquisition of data for demographic, ecological, health and disease research projects; to reduce handling and stress of individual animals; to avoid spread of infectious disease; to promote high quality and consistent data sets; and to reduce the duration and number of field trips. The field methods are adapted for desert tortoise life cycle, behavior, anatomy, physiology, and pertinent disease; however the model is applicable to other species of reptiles. Comprehensive databases of clinical signs of disease and health are crucial to research endeavors and essential to decisions on captive release, epidemiology of disease, translocation of wild tortoises, breeding programs, and euthanasia.

Key words: Chelonian, desert tortoise, diagnosis, disease, field evaluations, *Gopherus agassizii,* health assessments.

INTRODUCTION

Most research on populations of wild animals is conducted by wildlife biologists, zoologists, and ecologists without collaboration with veterinary medical specialists. Many research projects, especially those involved with rare and endangered animals, could benefit from the contributions of veterinarians and other health specialists (Boyce et al., 1992) at every phase. Veterinarians and wildlife health specialists can assist in identifying diseases and their ecological significance to wild animal populations, determining the effects of anthropogenic impacts (e.g., stress), and developing management options for recovery and rehabilitation (Kirkwood, 1993, 1994).

Research on the desert tortoise (*Gopherus agassizii*), a species of the arid southwestern United States and Mexico, provides an excellent model for how interdisciplinary teams of research scientists developed techniques to evaluate health and diagnose disease. The tortoise was listed by the federal government as a threatened species under the Endangered Species Act (ESA) of 1973 (as amended) over approximately 30% of its geographic range in the arid southwestern USA and Mexico in 1990, because several populations were experiencing declines (Fish and Wildlife Service [FWS], 1994; Berry, 1997a). Two recently described diseases, upper respiratory tract disease (URTD) and cutaneous dyskeratosis, were associated with population declines in some areas (Brown et al., 1994; Jacobson et al., 1995; Berry, 1997b). Upper respiratory tract disease is caused by *Mycoplasma agassizii* (Jacobson et al., 1991; Brown et al., 1994) and an as yet unnamed new mycoplasma organism (Brown et al., 1995). An enzyme-linked immunosorbent assay (ELISA) test was developed to measure antibodies to *Mycoplasma agassizii* in tortoises (Schumacher et al., 1993). URTD and exposure to mycoplasma, as evidenced by positive ELISA tests and presence of mycoplasma in nasal secretions by cultures or polymerase chain reaction tests, have been documented in tortoises at multiple sites in the Mojave Desert (Jacobson et al., 1995; Dickinson et al., 1995; Homer et al., 1998; Brown et al., 1999). Upper respiratory tract disease is a transmissible disease, often subclinical and generally chronic (Brown et al., 1994; Jacobson et al., 1995; Homer et al., 1998). Cutaneous dyskeratosis produces lesions on the shell and integument and is of unknown etiology (Jacobson et al., 1994), although environmental toxicants and nutritional deficiencies are suspected contributors (Homer et al., 1998).

We developed a model set of standardized field guidelines for collecting and analyzing qualitative and quantitative data on clinical and physical signs of health, disease, and trauma for wild desert tortoises. The guidelines and techniques were designed to maximize acquisition of data for demographic, ecological, health and disease research projects; to reduce handling and stress of individual animals; to avoid spread of infectious disease; to promote high quality and consistent data sets; and to reduce the duration and number of field trips. Techniques for recording journal notes and information about live tortoises were developed, tested, and revised between 1971 and 1998 at 27 study plots in the California deserts (e.g., Berry and Medica 1995; Berry 1997b) with >20,000 captures of wild tortoises. Most techniques for assessing health and disease were developed and tested between 1988 and 1998 at 36 sites in California with >5,000 captures of tortoises (e.g., Berry, 1997b; Henen et al., 1998; Homer et al., 1998; Brown et al. 1999; Christopher et al., 1999). These standardized field methods represent a productive collaboration between wildlife biologists, veterinarians and pathologists, and are applicable to other chelonians and reptiles.

PREPARATIONS FOR THE FIELD

Prior to initiating field work, project participants should familiarize themselves with the literature on wild desert tortoises to optimize time and expedite location of tortoises (e.g., FWS, 1994; Grover and DeFalco, 1995). The annual cycle of above-ground activity for tortoises varies according to location within the geographic range and depends on such environmental factors as number of freezing days per annum, timing and amounts of precipitation, day- and night-time temperatures, and the type of desert (FWS, 1994). The exact timing of above ground activity is also dependent on availability of forage, local weather patterns, and ambient daytime temperatures (Nagy and Medica, 1986; Ruby et al., 1994; Zimmerman et al., 1994; Henen, 1997), as well as the size and age of tortoises (Berry and Turner, 1986).

Wild tortoises are easily accessible (near entrances of their burrows or dens, or above ground) to the field worker about 1.7% of each year in the Mojave Desert (Nagy and Medica, 1986). They hibernate in late fall and winter, can be active above ground in late winter and spring, may estivate in summer, and may become active again in late summer and early fall. In the Sonoran Desert, the seasonal activity pattern is associated with monsoon rains, with tortoises active above ground primarily in summer and fall (Johnson et al., 1990). Immediately after emergence from hibernation in late winter and early spring, tortoises usually have a single activity period during the middle of the day, and shift to a bimodal pattern as ambient temperatures increase in late spring (Zimmerman et al., 1994). During drought years, tortoises can be considerably more difficult to locate above ground. To ensure success in planning field work and locating tortoises, the field biologist should gather information on regional climatic patterns and local weather conditions, particularly precipitation during the previous year, from National Oceanic and Atmospheric Administration weather stations. The windows of activity when field workers can easily capture the tortoises are narrow, so each tortoise should be processed quickly to maximize encounters and sample sizes.

Field workers should familiarize themselves with the full repertoire of postures, behaviors, and display patterns of healthy desert tortoises (Ruby and Niblick, 1994) and the contexts in which they normally occur. Courtship in the Mojave Desert, for example, may occur in any month in which tortoises are above ground, with intense mating activity in both spring (April–May) and fall (August–November) (Rostal et al., 1994a: Ruby and Niblick, 1994). Nesting occurs between April and July (Turner et al., 1986; Rostal et al., 1994a). The timing of reproductive activities may be different in tortoise populations in the Sonoran and Chihuahuan deserts. Field workers also should be knowledgeable of abnormal behaviors and signs of ill health and disease by reviewing the literature on wildlife diseases.

Wild desert tortoises are similar to other members of the Testudinidae and exhibit a wide variety of responses when captured. They can be tame and curious, try to escape, or retreat tightly into their shells, posing difficulties for a thorough examination of the accessible soft parts (limbs, head, and tail). Since the species is threatened and protected under the ESA of 1973, as amended, efforts must be taken to reduce stress and handling time and to release the tortoise at the site of capture within 15 to 20 min. To ensure expeditious processing, new field workers should practice under an experienced supervisor on legally held captive desert tortoises or other chelonians.

Effective and efficient data collection can be accomplished by following written protocols and recording data on standardized forms printed on archival paper. These forms should document background environmental data, individual tortoise data, and data from physical examination of the tortoise. The forms can be modified to suit special projects and other species, and can be handwritten or directly entered into portable computerized databases in the field.

JOURNAL NOTES

Journal Notes should provide background data essential for interpreting whether the activities and behaviors of tortoises are typical of ill or healthy animals, as well as for identifying potential sources of trauma, illness, or disease. Journal notes should contain survey times, numbers of live and dead tortoises observed, starting and ending times of field work, time expended in searching for and processing tortoises, and observations of other animals (Fig. 1). Details of actual times spent in observing tortoise behavior from a distance as opposed to handling are recorded in more detail on other data sheets (Figs. 2, 3).

Daily weather conditions can substantially alter the interpretation of tortoise activity levels, behavior and physiology, so Journal Notes should contain a daily summary of weather conditions. For example, a rainfall event during late spring, summer or early fall can stimulate *en masse* emergence of tortoises to drink and rehydrate (Henen et al., 1998). In contrast, precipitation during cold weather in winter is unlikely to elicit emergence when tortoises are hibernating. Similarly, if air temperatures exceed 40, a panting tortoise may be interpreted as being overheated and unable to find shelter (an abnormal situation). Therefore the field biologist should begin each day by recording percentage and type of cloud cover, amount and tim-

JOURNAL

Desert Tortoise (*Gopherus agassizii*)
Paradise Mountains
San Bernardino County, California

Date

Start & Finish Times (PST)

Areas Searched (by section & grid no.; map also)

Capture type 1:

Capture type 2:

Capture type 3:

Shells:

Other Capture types:

Names of field workers	Start & end times	Search times	Processing times	Total field time

Pacific Standard Time	Temperatures (°C) 1.5 m	1 cm	soil surface (shaded bulb)	Wind speed & direction	Cloud cover
0800					
1200					
1600					

min. temperature for the day:

max. temperature for the day:

HUMAN USES

People:

Vehicles (type & numbers):

Livestock:

Shooting:

Other:

Other Notes:

FIGURE 1. Sample data sheet for Journal Notes.

DO NOT ABBREVIATE **WRITE ON THIS SIDE ONLY**

Data Sheet for Live Desert Tortoises

Field Worker ____________ Tortoise ID Number ____________
Study site name ____________ Verification of ID ____________
Study site number ____________ Year first marked ____________
Township ______ Range ______ Capture Type ______ Sex ______
Section ______ Grid no. ______ Date (day/month/yr) ____________
COORDINATES (Reference SW corner) Time (PST): Start ______ End ______
______ meters North, ______ meters East On Plot ______ Off Plot ______
County ____________ ◄— Show location of tortoise in grid
State ____________

TORTOISE LOCATION

Cover site type: burrow ☐ pallet ☐ shrub ☐ caliche cave ☐ rock shelter ☐
At cover site: entering ☐ exiting ☐ on mound ☐ inside ☐
Not at cover site: in open ☐ other ☐ ______ ______ ______

COVER SITE DATA

For tortoises ≤140 mm MCL
orientation ____________
length ______ height ______
width ______ soil cover ______
location ____________
____

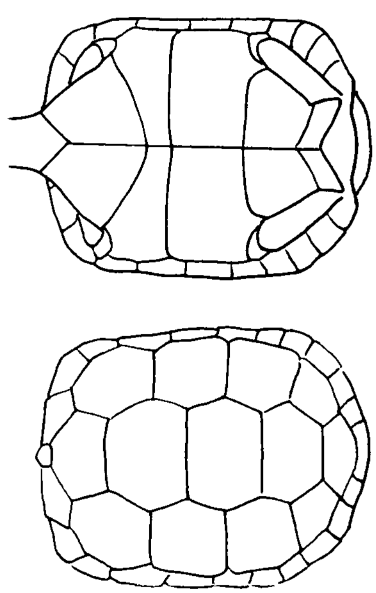
SURVEY TYPE

coverage 1 ☐
coverage 2 ☐
juv. search ☐
other ☐
______
______

TORTOISE ACTIVITY

resting ☐ walking ☐ Interacting with other tortoise ☐ ID & sex of other tortoise ____________
basking ☐ feeding ☐ Interacting with other animals ☐ other species ____________
Describe interaction: ____________
plants/items eaten (be specific): ____________ ____________

SPACE FOR MORPHOMETRIC MEASUREMENTS, ECOLOGICAL DATA, Etc.



BODY MEASUREMENTS

carapace length at midline, MCL (mm) ____________
plastron length (notch), PLN (mm) ____________

weight (g) ____________
void/feces (g) ____________
total weight (g) ____________

new growth: present ☐ absent ☐
epoxied #: present ☐ legible ☐

DRAW LOCATIONS OF NOTCHES (old and new), chips, and anomalies, etc.
Describe anomalies in numbering of marginals and any identification problems.

Other notes: ____________
____
____
____

Photo reference: roll ______ frames ______

Berry/livtort.3-1993(mac)

FIGURE 2. Sample data sheet for Live Desert Tortoises.

DO NOT ABBREVIATE **WRITE ON THIS SIDE ONLY**

Health Profile Form for Desert Tortoises

Field Worker ______ Tortoise ID Number ______
Study site name ______ No. ____ Year first marked ______
MCL ______ Weight (g) ______
Township ______ Range ______ Capture Type ______ Sex ______
Section ______ Grid no. ______ Date (day/month/yr) ______
County ______ State ______ Time (PST): Start ______ End ______
On Plot ______ Off Plot ______ Shell Wear Class ______

◄— Location of tortoise in grid

BEAK & NARES	YES	NO	UNK
Beak/nares wet	☐	☐	☐
Beak/nose damp	☐	☐	☐
Nasal exudate present	☐	☐	☐
Exudate color: clear	☐	☐	☐
cloudy	☐	☐	☐
white	☐	☐	☐
yellow	☐	☐	☐
green	☐	☐	☐
Bubble(s) from nares	☐	☐	☐
One nare occluded	☐	☐	☐
Both nares occluded	☐	☐	☐
Dirt on nose/beak	☐	☐	☐
Dirt in nares	☐	☐	☐
FORELEGS (adjacent to face)			
Dried dirt on forelegs	☐	☐	☐
Moisture on forelegs	☐	☐	☐
Dried exud. on scales[1]	☐	☐	☐
Scales cracking[2]	☐	☐	☐
BREATHING: Smooth	☐	☐	☐
Wheezing	☐	☐	☐
Rasping, clicking	☐	☐	☐
EYES, CHIN GLANDS *Circle eyes or lids:*			
Eyes/lids whitened or discolored	☐	☐	☐
Eyelids swollen	☐	☐	☐
Eyes/lids wet	☐	☐	☐
Discharge from eyes	☐	☐	☐
Eyes sunken	☐	☐	☐
Eyes clear, bright	☐	☐	☐
Eyes dull, cloudy	☐	☐	☐
Chin glands draining	☐	☐	☐
INTEGUMENT[3]			
Integument dull	☐	☐	☐
Integument glossy	☐	☐	☐
Normal elasticity	☐	☐	☐
Abnormal skin peeling	☐	☐	☐
POSTURE/BEHAVIOR			
Alert, responsive	☐	☐	☐
Lethargic	☐	☐	☐
Can withdraw tightly into shell	☐	☐	☐
Limbs, head hanging limp or loose	☐	☐	☐

ORAL CAVITY[4]	YES	NO	UNK
Observed	☐	☐	☐
Discharge present	☐	☐	☐
Membranes pink	☐	☐	☐
Membranes pale, white	☐	☐	☐
Smells/mouth rot	☐	☐	☐
EVIDENCE OF SHELL/BONE DISEASE			
Lesions present	☐	☐	☐
Lesions active	☐	☐	☐
Lesions healed	☐	☐	☐
Scute laminae peeling	☐	☐	☐
Scutes missing/peeling	☐	☐	☐
Pitting	☐	☐	☐
Scutes depressed/concave	☐	☐	☐
Fungal areas	☐	☐	☐
EVIDENCE OF TRAUMA			
Head	☐	☐	☐
Gular	☐	☐	☐
Forelimbs	☐	☐	☐
Hindlimbs	☐	☐	☐
Shell	☐	☐	☐
Bone/scute replacement	☐	☐	☐

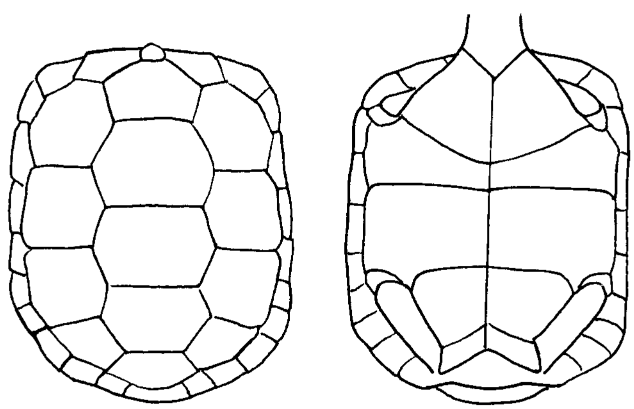
Describe: ______

Soil dryness: wet ____ damp ____ dry ____
Last Precipitation (day/mo/yr) ______

Urine (vol) ______
Color ______
Viscosity ______
Particulates ______
color ______
Nasal wash sample collected ______
No. of needle sticks ______
Time of needle sticks ______
Location ______
PCV% ______
Other samples taken ______
Describe/draw parasites ______
Other ______

LEGEND FOR DIAGRAM
- Pits in integument and/or shell
- Shell disease
- Trauma
- Ticks, mites

DRAW: shape of gulars, location of notches; chips, chews, shell damage, lesions; shell disease; shell abnormalities; scute concavities. Make new drawing at least once/year (spring).



OTHER NOTES: ______

Footnotes: 1 - Shiny integument, glossy with dried exudate. 2 - The integument can crack from effects of the exudate. 3 - Difficult, but try. For normal elasticity, gently pull skin on limb, note how quickly skin returns to position. 4 - Important. DO NOT try to open mouth. Make observations opportunistically, if tortoise opens mouth.

Berry/HealthProf.4-1995(mac)

FIGURE 3. Sample Health Profile Form.

ing of precipitation, temperatures, and wind speed. Air temperatures, recorded with a Schultheiss or Miller and Weber (Miller & Weber, Inc., Ridgewood Queens, New York, USA) quick-reading thermometer (0–50 C), are taken at 1.5 m, at 1 cm above the soil surface (shaded bulb) and on the soil surface (shaded bulb) at least three times daily (0800, 1200, and 1600 PST) and can be recorded also at the location of capture of each tortoise. Since many facets of tortoise behavior, physiology, and health are closely tied to nutrition and food intake, field workers should record the current and recent availability of fresh, green, succulent plants and recently dried plants used by tortoises for forage. The ability to observe and record such information presupposes that field workers have familiarized themselves with the diet and the locally preferred plant foods and are able to identify the plants in the field.

Journal Notes should contain detailed data on locality of study sites, e.g., latitude, longitude; township, range, and portion of section; universal transverse mercator (UTM) grid coordinates; county; and elevation. Some permanent sites (FWS, 1994; Berry and Medica, 1995) have survey poles at intervals of 100 to 165 m, so that locations of tortoises can then be estimated in meters by pacing to the nearest pole. At other sites, global positioning systems have been used to determine localities within 50 to 100 m. The precise locations of tortoises are critical for interpreting sources of trauma and toxicants and causes of some diseases.

All parameters related to human activities on and in the vicinity of the study site should be recorded both in Journal Notes and on a detailed map, because they may be critical factors in monitoring the long-term well-being of the population (Boyce et al., 1992; FWS, 1994). Examples include: distribution and densities of vehicle tracks, trails, paved and dirt roads; numbers and types of vehicles; numbers of visitors unrelated to research work and their purposes for visitation; sheep and cattle; observations of individual cats or dogs or packs of dogs; locations and types of refuse or hazardous waste; mining markers or stakes; mill sites; campsites; and evidence of shooting of firearms (shotgun shells, clay pigeons, targets). Historical information should also be recorded when deemed important: abandoned mines and mill sites, abandoned or active railroads, abandoned or active vehicle routes, previous military maneuver or bombing areas, ranching or farming operations, proximity to utility lines and incinerators, etc. Desert tortoises have been found with tar on scutes or caught in tar, with gunshot wounds (Berry, 1986), traumatic and fatal injuries due to military projectiles and tanks, and in the vicinity of hazardous waste materials. Desert tortoises may also become entangled in or consume foreign objects, e.g., string, rubber bands, surveyors tape, aluminum foil (K. Berry, unpubl. data), similar to reports of other chelonians (Balazs, 1985; Reidarson et al., 1994; Mader, 1996).

PROCEDURES TO PREVENT SPREAD OF DISEASES AND PARASITES

Special precautions must be taken to prevent transmission of pathogens causing diseases such as mycoplasmosis (Brown et al., 1994; Jacobson et al., 1995) within and between tortoise populations (Jacobson, 1993, 1994a; Berry, 1997b). The most likely sources of transmission of mycoplasmosis are direct contact, nasal exudate, and aerosols (Brown et al., 1994). The role of mucous droplets in burrows has not been studied and cannot be ruled out.

Each tortoise should be handled with a fresh pair of disposable gloves, which is placed in a plastic trash bag after use and discarded appropriately off-site. Each item of equipment (scales, calipers, ruler) touching the tortoise, including poles used to probe tortoise or other animal burrows and to tap tortoises from burrows (Medica et al., 1986), must be disinfected with a sodium hypochlorite solution (0.175%) or ethanol (70%) immediately after each use and before being replaced in the carrying case or pack. The sodium hypochlorite solution should be made fresh at least once per week, with both concentrated and diluted solutions protected from excessive heat and sunlight. Precautions must be taken to assure that the tortoise does not touch or rest on the field worker's limbs, clothing, or equipment without protective covering. Other options are to use disposable jump-suits and disposable plastic shoe covers. To prevent contamination, small pieces of disposable paper or plastic sheeting can be placed under the tortoise or on the lap of the field workers. To prevent transmission of disease between study plots, field workers should not travel directly from one site to another without bathing and changing clothes and shoes. Clothes and shoes must be disinfected prior to use on other sites. Depending on the nature of the diseases present at the site, field vehicles may require thorough external and internal cleaning at a car wash.

Careful adherence to the above procedures can also help to reduce transfer of ticks, potential vectors of disease, to humans. The two species of ticks commonly observed on desert tortoises, *Ornithodoros parkeri* and *O. turicata* (Greene, 1983, 1986) are major vectors of the disease agents *Borrelia parkeri* and *B. turicatae* which cause American tickborne relapsing fever in people (Sonenshine, 1993). Humans are rarely involved in the cycle of transmission of these diseases unless they intrude into home sites or nests of the ticks, e.g., tortoise burrows. While no cases of borreliosis transmission from tortoise ticks to humans have been documented, field workers should take precautions when processing tortoises, because *O. parkeri* (and probably *O. turicata*) were found on 5 to 10% of wild desert tortoises in several tortoise surveys conducted between 1970 and 1980 (Greene, 1986). At one site, 43% of active tortoise burrows were infested with *O. parkeri*.

DATA SHEET FOR LIVE DESERT TORTOISES

The Data Sheet for Live Desert Tortoises (Fig. 2) is used for recording basic demographic and ecological data for each tortoise observed and/or captured and contains parameters useful for calculating condition indices and equations related to carapace length and mass. Desert tortoises are long-lived animals, requiring 12 to 20 or more years to reach sexual maturity, and may then live at least 70 or more years (Woodbury and Hardy, 1948; Hardy, 1976; FWS, 1994). Because of their longevity, careful records are essential for determining ecological and behavioral constraints; individual and population growth rates; recruitment of young into adult age classes; survivorship by cohort; causes of mortality; and frequency and types of trauma and disease. Critical parameters include: date, time and precise location of capture; unique tortoise identification number; type of capture (e.g., 1 = first capture, 2 = subsequent recaptures during the year [any year], 3 = first capture of the year for a previously marked tortoise, 5 = a marked tortoise found dead); sex, body measurements and weight; and activities and behaviors.

Each tortoise should be examined to determine whether it is a released captive or previously marked animal from a translocation project or an unauthorized translocation. Signs of previous captivity include: painted initials, numbers, or other writings on the shell; shell discoloration or stains from dyes, ink or paint; file marks or holes drilled in the marginal scutes of the carapace; caked dirt of a different color and type than the parent rock and soils of the study site; and fiberglass, epoxy, or other manufactured materials. Captive tortoises frequently have morphologic anomalies, such as pyramid-shaped scutes (Jackson et al., 1976). Tameness and curiosity are not valid criteria for assessing previous captivity of desert tortoises. Field workers should also ensure that the tortoise is a desert tortoise and not some other *Go-*

pherus spp. or exotic tortoise that was illegally released, by becoming familiar with dichotomous keys and descriptions of similar-appearing species.

Placing a unique identifying mark on a tortoise requires considerable care, because the identification number ideally should last the life of the tortoise. First, field workers must record physical anomalies (shape and number of scutes) on the carapace and plastron diagrams (Fig. 2). Second, based on scutellation, an identifying number is selected and notches are filed in the scutes with a triangular file. Most tortoises ≥100 mm mid-carapace length (MCL) are notched on one or more of the marginal scutes using a standard numbering system. Tortoises <100 mm MCL are notched only on anterior or posterior marginal scutes either with a small triangular file or with nail clippers; the bridge (portion of the shell between the carapace and plastron) is avoided, because notches can penetrate to the bone in this area. Most notches are filed or cut into the keratin of scutes without penetrating to or notching the bone. When scutes are thin, the notch can expose a thin sliver of bone, which may stimulate replacement of both scute and bone and subsequent disappearance of the notch itself. Notches generally are evaluated each year a tortoise population is surveyed and remade or deepened when ambiguous or no longer clearly distinguishable. Notches have remained >20 yr on some desert tortoises, but may wear away as the tortoise ages, or may disappear if marginal scutes chip or are chewed by predators. Third, the identification number is placed on a scute as a supplemental identification. A dot or smear (about 5–8 mm in diameter) of cream-colored or pale yellow paint is placed on the areola or area formerly covered with the areola of the fourth right costal scute, a site with minimal abrasion, and allowed to dry. Then the number is written on the dried paint. The dot and number should be sufficiently small and obscure to preclude loss of the natural concealing colors of the tortoise shell. The number is covered with a small dot of Devcon (Devcon Consumer Products, Wood Dale, Illinois, USA) 5 min quick drying epoxy. The number may become obscured if the surface of the epoxy is scratched or covered with dirt, but it can often be read several years later when moistened and rubbed. The painted number reduces field time and handling, because field workers can rapidly identify the tortoise and determine if it was recently processed.

Additional forms of identification include passive integrated transponder (PIT) tags and radio transmitters. The PIT tags can be fastened with epoxy to the dorsal or ventral surface of marginal scutes (Boarman et al., 1998) or injected subcutaneously into the body (a practice which has not been perfected and which we do not advise). The first three forms of identification, coupled with the photographs described below, are essential.

On the first capture of the season and at subsequent capture intervals of two or more weeks, tortoises should be measured for MCL and plastron length from gular to anal notch. We prefer Starrett (L. S. Starrett Co., Athol, Massachusetts, USA) firm joint outside calipers and a 380-mm metal ruler (1 mm increments) for individuals >125 mm MCL, and dial calipers (130–150 mm, 0.05 to 0.1 mm increments) for individuals <125 mm MCL, although some researchers use tree calipers. Depending on the size of the tortoise, mass can be recorded using a 100 g Pesola (Geneva, Switzerland) scale (1 g increments) and varying sizes of Chatillon (John Chatillon and Sons, Kew Gardens, New York, USA) scales (1 kg, 20 g increments; 6 kg, 50 g increments; and 12.5 kg, 100 g increments). Tortoises can be suspended in clean plastic bags, or with disposable slings of surveyor's tape or string. Expensive and inexpensive electronic balances are also available but are not necessarily appropriate for carrying in a backpack for processing tortoises a few kilometers from the vehicle.

Several veterinarians have used the relationship of body weight to carapace length to evaluate clinical condition of tortoises, e.g., "Jackson's ratio" (Jackson, 1980; Spratt, 1990; Blakey and Kirkwood, 1995). For the desert tortoise, reliable predictions of health based on weight and carapace length data have not been fruitful, probably because so many different factors (sex, reproductive status, degree of hydration, morphology of the shell) contribute to weight (Jacobson et al., 1993). Another approach is the development of a condition index such as body mass (g) divided by the cube of MCL (Wallis et al., 1999; see also Bonnet and Naulleau, 1994 for a different method).

The sex of each tortoise ≥180 mm MCL is assigned using several secondary sex characteristics: MCL, presence and condition of chin or mental glands (Alberts et al., 1994), size and curvature of the gular horn, the presence or absence of a concavity on the posterior plastron, and tail length. Reliable sexing of individuals <180 mm MCL requires laparoscopy (Rostal et al., 1994b) and is rarely done in the field. Smaller tortoises are assigned, unsexed, to juvenile (<100 mm MCL) or immature (100–179 mm MCL) size classes. Sexing a young or small adult (180–205 mm MCL) can be difficult, because the upturned gular horn and plastral concavity typical of males are unlikely to be well defined or fully developed until the tortoise is >210 mm MCL. Gular horns of males are often damaged by predators, and some males may not have an intact gular to evaluate. In contrast to males, the posterior plastron of a female is almost always flat or imperceptibly concave. The female gular is almost always flat, or only the lateral edges are slightly upturned. Tail length, a trait that changes with age, is longer in the male than the female. In young or small adults, the differences can be only a few mm. As the male ages and grows larger, tail length increases and differences between the sexes become more pronounced.

Two paired integumentary chin or mental glands are located below the mandibles (Alberts et al., 1994) and can be used to determine sex in adults. The volume of adult female chin glands is so small that secretion samples cannot be collected. In contrast the volume of adult male chin glands is greater, secretions can be collected, and the gland volume varies according to season. Male chin glands are relatively small in late spring and peak in size in late summer, a time when courtship, mating and aggressive behaviors frequently occur. Mean gland volume of males is also positively correlated with mean plasma testosterone concentration (Rostal et al., 1994a; Alberts et al., 1994) and is generally greater in dominant males than in subordinate males (Alberts et al., 1994). When the sex is in doubt or the field worker has limited experience, 35-mm slides should be taken of the head, chin glands, gular, posterior plastron and tail for retrospective evaluation by an expert.

The precise location of each tortoise is essential to record. Tortoises exhibit fidelity to burrows and dens, have established home ranges, and can spend a lifetime within limited, circumscribed home ranges or activity areas (FWS, 1994). As such, they can serve as sentinels of environmental conditions. When capture sites are accurately recorded, animals can be recaptured more easily for health evaluations, salvage, or demographic studies.

To determine whether the tortoise is or has been actively growing within the last few months, the seams between scutes should be inspected for the presence of a narrow (generally <2 mm) band of softer grey or lightly pigmented keratin. Within a few months the band will harden and form a new ring, gradually assuming the color of the portions of the scute adjacent to the seam. These lines or rings do not represent annular rings, because no rings or more than one ring may be formed in a single season (Zug, 1991).

THE HEALTH PROFILE FORM

The Health Profile Form (Fig. 3) was developed to assess health and well being of the tortoise and was revised several times between 1989 and 1998. It incorporates standard parameters used to evaluate captive chelonians (Jackson, 1987, 1991; Mautino and Page, 1993; Mader, 1996), as well as new parameters associated with recently described and commonly observed diseases. Field workers preferred the single page, circling or checking responses, and a limited protocol. We obtained the best results from the form shown in Figure 3, coupled with photographs. There is some overlap in the Live Tortoise Form and the Health Profile Form, enabling the development and use of separate databases by interdisciplinary teams of research scientists.

The tortoise should first be observed from a distance, and if possible, before it responds with defensive or aggressive postures or movements. Critical factors include postures, particularly position of the head and limbs, and movement of the limbs and body; activities and behaviors; and general and specific locations in the environment. Shortly after emergence from hibernation in late winter or early spring, the normal suite of behaviors includes: basking at the mouth of the burrow or on the burrow mound with limbs fully extended and directed forward with the plastron on the soil, walking, foraging, resting in the shade of a shrub or tree, or (late in the day) facing into the burrow, partially down or at the end of the tunnel. Atypical and abnormal behaviors include: remaining overnight above ground in freezing temperatures or remaining in the same place outside the burrow for more than one day at any time of year. One abnormal posture signals chronic illness: the tortoise rests with head down and partially withdrawn, forelegs partially spread apart and with the dorsal surface rotated outward and forward. The limbs are limp and the tortoise appears lethargic and weak. Lethargy and weakness in a free-living tortoise are clinical signs of chronic disease. During the activity season (March–October), most tortoises should be alert and responsive under normal operating temperatures (Berry and Turner, 1986; Zimmerman et al., 1994), and able to withdraw head and limbs quickly and tightly into the shell when prodded. If environmental temperatures are at or near freezing, or skies are overcast and weather generally cold, the responses of a normal, healthy tortoise will be slower.

Observations of the limbs, head, beak, nares, eyes, chin glands, and oral cavity can be difficult or impossible to make if head and limbs are retracted tightly into the shell in a defensive posture. With field time at a premium, the field worker may have to abandon attempts to record most health data on such tortoises. If, however, the health profile evaluation is performed after the Data Sheet for Live Desert Tortoises is filled out, then the tortoise may relax and become curious. One technique to expose the limbs and head is to place the tortoise right side up on an inverted coffee can covered with a single-use clean paper towel. Some tortoises will extend head and limbs and flail, allowing an excellent view and an opportunity to photograph eyes, nares, and head.

The shell and integument should be evaluated when clean. Most shells have a little, easily removable dust and dirt. When wiped and rubbed free of dust and dirt, the integument should be glossy. After rain, some tortoises become so heavily caked in dirt or mud that the shell must be cleaned with a brush and the extremities rinsed with water prior to examination. For the shell and scales, important factors to consider are whether scales and scutes are clean and glossy (similar in appearance to the skin of a snake that has freshly shed) or are dull, dried-out in appearance, discolored, caked with dirt or mucus, or covered with fungi.

The general appearance of limbs and head are indicators of health status. An emaciated head, sunken eyes, and emaciated or cachectic limbs may be signs of dehydration, starvation or chronic URTD. Other factors to look for include swollen limbs, neck, and cloaca; and swellings in the inguinal or axillary area.

The beak, nares, eyes, and chin glands provide subtle signs indicative of health or disease. Since the desert tortoise lives in an arid environment and frequently experiences drought, dehydration, and accompanying weight loss (Henen et al., 1998), it may not always exhibit obvious clinical disease signs such as nasal and ocular discharges. Nasal and ocular discharges may be intermittent. Therefore, the field worker must look for evidence of recent moisture associated with the eyes, nares, and beak. Tortoises with rhinitis or URTD may have wet or damp nares, and nasal exudate. The amount, color, consistency, and turbidity of any exudate (e.g., clear, cloudy, white, yellow, and green) should be recorded (Jacobson et al., 1991). Tortoises may blow bubbles from the nares or one or both nares may be occluded. On rare occasions, a healthy tortoise may exhibit what appears to be a clear nasal discharge, possibly associated with consumption of lush, succulent vegetation in spring. Dirt adhered to dried mucus on the beak or nares may be a sign of illness, but tortoises that have been drinking from depressions in the soil during a thunderstorm may also have dirt on the beak, nares and forelimbs. Tortoises with a tenacious exudate may have moisture or dried dirt on the medial surface of the forelegs from wiping the face, eyes, and beak with their forelegs. In severe cases, the integument between the scales of the forelegs may have cracked. Inflammation and congestion of the respiratory tract may alter breathing, so respiratory sounds should be evaluated for wheezing, rasping, and clicking noises. Severely affected individuals may extend their necks and open their mouths to breath. Consequently, breathing may look and sound labored.

The color, surface, and condition of the beak may reflect health status as well as recently consumed food items. When forage is plentiful, the beak should have green or other colored stains from recently consumed leaves, flowers, and fruits. Occasionally beaks will be caked with dried flesh of cactus fruits or dried sap from plants. In years when forage is plentiful, the observer should suspect illness in a thin, low weight, inactive tortoise that shows no evidence of recent food consumption or color on the beak. The chin or mental glands may be abnormally swollen and draining. If swollen, the dimensions of each gland should be measured to estimate volume (see Alberts et al., 1994 for measurements and formula).

The surface of the eye, appearance of palpebrae (eyelids), and periocular region should be examined closely for abnormal color; presence of dampness, mucus or drainage; and edema—all of which may be signs of URTD (Jacobson et al., 1991; Brown et al., 1994), rhinitis (Jackson, 1991) or other illnesses. The palpebrae are normally dry, unscaled, wrinkled, and delicate in appearance (Fig. 4A–C). The periocular area, separated dorsally and ventrally from the palpebrae by a furrow, is covered with small scales and is also normally dry and flat. The normal surface of the globe usually does not have visible strands or patches of mucus. To assess the eye and adnexal structures, we developed a grading scheme for the palpebrae and periocular areas. Palpebrae should be evaluated for swelling (edema) and dampness (Fig. 4D–L), and the periocular area surrounding the eye also may be swollen (Fig. 4E–K; also compare Fig. 4C with Fig. 4H). The degree of closure of lids on both eyes should be noted, as well as outward bulging, swelling or a sunken appearance within the orbit (compare Fig. 4C with Fig. 4H and 4L). Clinical signs (Figs. 3, 4) should be rated by degree of severity in each eye, with 1 = normal, 2 = mild, 3 = moderately severe, and 4 = severe or marked. Ratings may be accomplished with supplements (e.g., Appendix 1) to

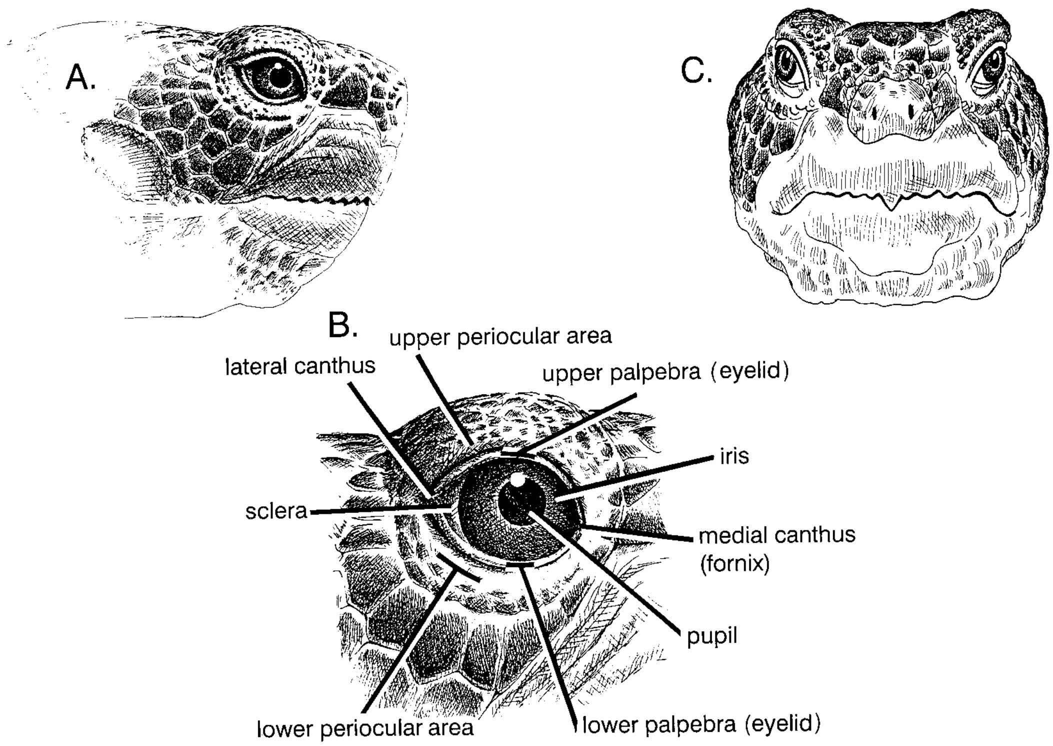


FIGURE 4. A–C. Line drawings of the desert tortoise head depicting anatomical landmarks. A. Lateral view of normal eye, palpebrae (eyelids) and periocular area in the context of the tortoise's head. B. Magnified lateral view of the normal eye, with upper and lower palpebra (lacking scales), periocular areas (scaled) and other anatomical structures denoted. C. Frontal view of the head and normal eye area.

standard health forms (Fig. 3). Appendix 1 is for the well-trained or advanced field biologist working with diseases of the eye or upper respiratory tract.

The mouth of the tortoise is usually closed and separating the jaws is likely to induce additional stress. Unless the research program is focused on health and diseases, we recommend that data on the oral cavity be gathered opportunistically if the tortoise gapes or if the mouth is easily opened. The tongue is covered by a thick layer of cornified epithelium and the mouth has numerous mucous glands (Barboza, 1995). If the oral cavity is examined, the following data should be recorded: smell; general color and localized spots; and the presence of plaques, swellings, blisters, ulcers, stains, lesions, and foreign objects (e.g., embedded plant spines).

Wild desert tortoises >120 mm MCL are likely to have some lesions on their scutes, underlying dermal bone, and/or extremities. Occasionally to frequently, field

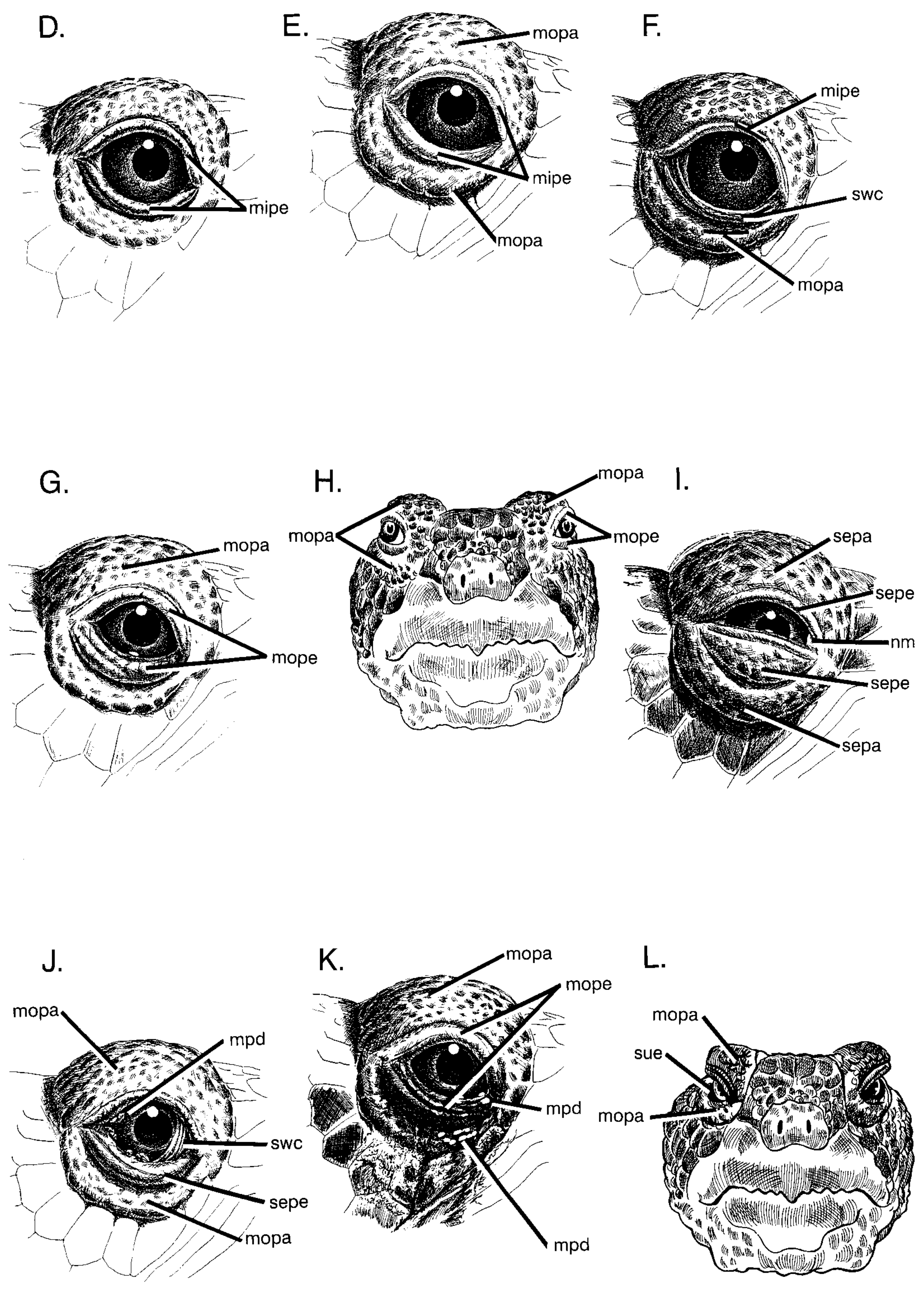


FIGURE 4. D–L. Same as 4 A–C showing ocular abnormalities commonly associated with upper respiratory disease infection and other ocular disorders. Abbreviations for D–L: mipe = mild palpebral edema; mopa = moderate edema of the periocular area; mope = moderate palpebral edema; mpd = mucopurulent discharge; nm = nictitating membrane; sepa = severe edema of the periocular area; sepe = severe palpebral edema; sue = sunken, recessed eyes; swc = swollen conjunctiva. D. Mild edema (chemosis) of the upper and lower palebrae. E. Moderate edema of the palpebrae, conjunctiva, and upper and lower periocular areas.

biologists observe: chips of keratin and bone missing from marginal scutes; missing limbs, toenails, or scales on limbs; healed or healing tooth marks, chew marks or punctures (penetrating scute to bone) from predators; cutaneous dyskeratosis (Jacobson et al., 1994; Homer et al., 1998); depressions in scutes and underlying bone; and exposed, white or dark discolored bone, potentially indicative of necrosis (Homer et al., 1998). The location of all lesions should be drawn on the diagrams of scutes, described carefully, and photographed. Signs of predator attack should include notes on the potential predator (including feral dogs and cats), as indicated by size, location, and type of puncture, scratch or tear. The relative age of the wound or lesion should be recorded. Wounds or lesions may be fresh, in the process of healing, or evident as scars. Such data, when compiled over several years, can be used to: (1) compare survivorship of the different age classes of tortoises to predator attacks, and (2) measure predator pressures on populations. For example, the technique of recording scars of predator attacks has been successfully used with the scorpion mud turtle (*Kinosternon scorpioides*) to measure predation pressure by jaguars in different habitats (Acuña-Mesen, 1994).

Most desert tortoise populations contain individuals with cutaneous dyskeratosis, as manifested by discolored and flaky scutes. The lesions usually are associated with the seams of the plastron and spread outward from the seams in irregular patterns (Jacobson et al., 1994; Homer et al., 1998). The damaged portions of scutes are whitish grey, sometimes orange, slightly raised and flaking. In severe cases, tortoises with thin, peeling laminae and exposed bone may be more vulnerable to bacterial and fungal infections and predation (Homer et al., 1998). Cutaneous dyskeratosis and other shell diseases should be graded by distribution on the shell, severity, and approximate age of lesion or chronicity for each of three body regions, the carapace, plastron, and limbs (Table 1). A variation of the scale shown in Table 1 can also be used to record the presence of fungi, which may be present on tortoises that hibernated in damp or wet burrows.

Depressions in scutes should be recorded on the Health Profile Form and carefully photographed. Depressions in juvenile and immature tortoises (<180 mm MCL) may be due to malnutrition and metabolic bone disease, whereas in old adult tortoises the depressions may be a normal part of the aging process. Vermiculations between the scute and bone should be noted.

If the tortoise urinates (which frequently occurs when a hydrated tortoise is handled), the amount, color, viscosity and size of particles in the urine sediment should be evaluated. The color of normal urine is dependent on the level of hydration, with colorless, clear urine produced by a fully hydrated animal and very dark brown and concentrated urine typical of a tortoise dehydrated from prolonged drought (Nagy and Medica, 1986; Peterson, 1996a). The

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F. Mild edema of the upper and lower palpebra, moderate edema of the periorbital areas. G. Moderate edema of the palpebrae, with dorsal and lateral displacement of the eye from moderate edema within or adjacent to the orbit. Palpebra with this degree of swelling may appear translucent. H. Frontal view of 4G. I. Marked or severe edema of the upper and lower palpebrae and periorbital areas, with bulging of the eye laterally. The scaled periocular area is swollen into prominent folds or bags, resulting in partial closure of the eye. The nictitating membrane (3rd eyelid) is visible in the fornix (arrow). J. Similar to 4G, with mucus on the eyeball surface, spilling onto lower lid, and swollen conjunctiva. K. Moderate edema of the palpebrae and periorbital areas. Mucoid or mucopurulent discharge has accumulated in the medial canthus (fornix) area and spilled over onto the surrounding skin. Dirt may admix with the mucus, resulting in dried dirty crusts around the eye. L. The sunken eye, partially closed.

TABLE 1. System for grading shell lesions such as cutaneous dyskeratosis in desert tortoises. The carapace, plastron, and integument on limbs and head should be rated separately.

I.	Shell lesions: source
	1 = From trauma
	2 = From disease (specify cutaneous dyskeratosis, necrosis, fungi, or other)
II.	Distribution: specify by plastron, carapace, limbs, or head
	1 = Not present, no signs of lesions
	2 = Mild, lesions manifested primarily at seams, covers less than 10% of plastron (or carapace or limbs, etc.)
	3 = Moderate, covers 11%–40%
	4 = Severe, covers > 40%
III.	Severity of lesions (from disease, e.g., cutaneous dyskeratosis)
	1 = No lesions
	2 = Mild, discoloration follows edges of lifting laminae, lightly discolored, flaking
	3 = Moderate, discoloration extends over several layers of laminae, edges of laminae flaking, scutes may be thin in small areas, and potential exists for small holes and openings exposing bone
	4 = Severe, some scutes or parts of scutes eroded away or missing and bone exposed, eroded, or damaged
IV.	Chronicity of lesions (from disease, e.g., cutaneous dyskeratosis)
	1 = No lesions
	2 = Old lesions, no apparent recent activity, signs of regression or recovery; development of healthy, normal laminae is apparent at seams of scutes
	3 = Active, current lesions

urine may be various shades of yellow, burgundy, or brown color and contain gelatinous material and precipitated urate crystals ranging from greyish white to pink, yellow, and brown in color. Since survivorship of tortoises may be affected by loss of bladder fluid (Averill-Murray, 1998), protocols for handling tortoises should minimize contact time. Fecal samples should be collected when available for analysis of internal parasites.

All ectoparasites on tortoises should be considered significant (Jacobson, 1994b). Ticks can injure a tortoise or transmit parasites, spirochetes, or viruses (Sonenshine, 1993). Records should be compiled by species of tick and should include (for each tick): numbers, attachment site or location in general (e.g., number and name of scute), specific attachment site or location (pit, chip, seam, new growth tissue, injury), size, developmental stage, sex, degree of engorgement, and activity (resting, feeding, moving) (Fig. 3). Recent attachment sites, such as small bloodied areas of seam between scutes, should also be recorded. Reference specimens should be collected and stored in appropriate museum collections, and the taxonomic identification should be confirmed (see Sonenshine, 1993 for methods). The ticks should be removed for accurate counts, identification, and determination of sex.

The most common ectoparasites recorded for desert tortoises are the nidicolous Argasid ticks, *Ornithodoros parkeri* and *O. turicata* (Greene, 1986). Their life span is at least several years (20 years in the case of some argasid ticks), and they can survive long periods of starvation (Sonenshine, 1991). All stages of these ticks parasitize wild desert tortoises (Greene, 1986). They tend to be found on the posterior carapace, often attaching at the seams between scutes, or at the site of old injuries. Attachment at a site of injury is also typical of *Hyalomma aegyptium*, the tortoise tick that parasitizes *Testudo graeca* (Petney and Al-Yaman, 1985). Other ticks, e.g., *Amblyomma marmoreum* on *G. paradalis*, showed patterns of seasonal abundance, as well as gender preferences for site attachments (Rechav and Fielden, 1995).

PERMANENT PHOTOGRAPHIC RECORDS

Full-frame images of the head, carapace, plastron, and the fourth costal scute of each tortoise should be taken with 35-mm slide film at least once during each survey year for identification, to gather data on numbers of growth rings produced and how the growth rings change in appearance over time, to verify how contours of the shell age, and to confirm how damaged shell replaces itself over time. Additional photographs can be taken of recent or previously healed injuries to the head, limbs, or shell, or unusual abnormalities. The 35-mm slides are useful for confirming identification of tortoises which have not been observed for many years, which had very small notches when marked as juveniles and grew to large adults without being captured in the intervening period, or which have lost one or more notches from predator attacks. The relative sizes of scutes and seams form unique patterns which persist from the late juvenile sizes through life, much like a fingerprint. Slide transparencies and permanent notches on the shell were used to identify desert tortoises illegally taken from the desert in May 1993 and to support a court case (K. H. Berry, unpubl. data). Similarly, the British Chelonian Group has set up a registration program for captive tortoises using photographs for identification (Jackson, 1991).

Even when tortoises have died and only part of the shell persists, the identities can be determined by using a combination of 35-mm slides, numbers on the costal scutes, and notches in one or more scutes. Disarticulated scutes and bones can be reassembled and the pattern of scutes discerned on the external surfaces of the bones. Notches or the indentation from notches often can be seen in the marginal and bridge bones.

Permanent photographic records have proved invaluable for retrospective analyses of progression and regression of signs of diseases in individual animals and populations, including cutaneous dyskeratosis and other shell lesions (Jacobson et al., 1994; Homer et al., 1998); URTD (Brown et al., 1999); traumatic injuries; and epidemiological research. Photographs also have proven to be a valid and reliable approach for grading trachoma in humans (West and Taylor, 1990). Close-up views of eyes and shells of the tortoises were especially critical for interpretation and grading of diseases and trauma (e.g., Jacobson et al., 1994; Brown et al., 1999; Christopher et al., 1999) and proved more reliable and consistent than the field evaluations.

Research veterinarians or health specialists can interpret slides and photographs and recommend whether to have a veterinarian visit the animal(s) in the field or to salvage the tortoise for necropsy. For consistent and effective interpretation, the film (manufacturer, brand, and speed) should remain the same for the entire project, because different types of films (with subtle color shading) render consistent interpretation difficult. For ease in storage, handling, and making comparisons, we recommend 35-mm slide transparencies and storage in archival slide sheets. New technologies, e.g., digital images archived on compact disks, are now available and offer numerous opportunities, such as automating assessments of health and disease and comparing different images of the same animal. For long-term projects with long-lived species, researchers should determine the level of detail available from film versus pixelated images, stability and longevity of the media, and ability to retrieve usable images after decades.

Cameras, including macro lenses, should be essential field equipment, and the ability to produce high quality, close-up photographs should be a job requirement. Lighting is critical for photographing animals, so skill with flash units should be another prerequisite for field workers.

SALVAGING ILL TORTOISES FOR NECROPSY

Necropsies of ill, dying, or recently dead wild tortoises provide a wealth of information about causes of death in populations and should be incorporated into field research protocols (Homer et al., 1998). Preparations for salvaging live or dead wild tortoises for necropsies must be made in advance by obtaining appropriate permits from the U.S. Fish and Wildlife Service and state fish and wildlife agencies, arranging for the services of a veterinary pathologist familiar with reptiles, identifying the types of tests to be made, and determining requirements of air freight lines

TABLE 2. General condition of 59 desert tortoises salvaged for necropsies between 1989 and 1996 on the senior author's scientific research permits.

	Condition of tortoises at time of salvage				
			Ill		
	Dead	Dying	Alert[a]	Lethargic	Pathologist or reference
			12		Jacobson et al., 1991
	1		3	2	E. R. Jacobson and J. Gaskin (Bureau of Land Management [BLM] files, 1990)
	1		2	2	J. Klaassen (BLM files, 1991)
	2	3	11	8	Homer et al., 1998
	8	0	4	0	Homer et al., 1998
Totals	12	3	32	12	

[a] Ill but alert tortoises were generally salvaged on the basis of clinical evidence of upper respiratory tract disease or shell lesions.

(shipping boxes, shipping papers). If a forensic necropsy is required, a veterinary pathologist with formal training, board certification by the American College of Veterinary Pathologists, and experience with reptiles should be obtained (Wobeser, 1996).

More data can be obtained from a live tortoise than from a dead tortoise. Frozen remains are of limited value for most pathologic studies, other than gross visual examination and toxicant analyses. We ship live tortoises packed in loose newspaper in two sizes (13.5 cm high × 70 cm long × 70 cm wide; 25 cm high × 70 cm long × 70 cm wide) of specially made plywood boxes with screw-top lids cut with 27, 2-cm in diameter holes (nine holes on the top, six holes on each of three vertical sides). The boxes are designed to allow the tortoises to move about, but the limited vertical clearance inhibits climbing and overturning. Information about the live animal, shipping times and routes, name and phone numbers of the receiving veterinarian, the health and scientific research and salvage permits are placed in an envelope and taped to the top of the container. Recently dead (<48 hr) tortoises can be shipped chilled on ice in an ice chest via one of the 24 hr mail services. Frozen remains can be shipped on dry ice.

Decisions on criteria for salvage require advance planning and can be placed in three categories: (1) opportunistic salvage of recently dead tortoises, (2) opportunistic salvage of severely injured and dying tortoises, and (3) the deliberate and planned salvage of animals with specific behavioral abnormalities, signs of disease or syndromes for special research projects. We retrospectively evaluated records of 59 desert tortoises removed from the wild between 1989 and 1996 (Table 2), and developed salvage criteria using clinical signs of disease and abnormal behavior. The criteria for salvage are met when tortoises have one or more of the following attributes: (1) is severely injured and unlikely to survive as a result of vehicle-related or predator-caused trauma; (2) is lethargic, inactive, or non-responsive during the activity season; (3) is emaciated or severely dehydrated and of very low weight for the carapace length; (4) exhibits progressive weight loss over a 1- to 2-yr period, not associated with drought; (5) exhibits abnormally low growth rates over a several-year period; (6) exhibits weakness associated with limb atrophy; (7) exhibits cachexia with no apparent weight loss (may have uroliths); (8) is incapable of retracting limbs into the shell or is partially paralyzed; (9) has active shell lesions (from cutaneous dyskeratosis or necrosis, not trauma) covering ≥40% of the plastron or carapace; (10) has scutes sloughing or loose, if the loosening and sloughing are not part of a healing or scute replacement process from trauma; (11) has scales peeling or sloughing from the limbs or head in patches, not due to trauma; and (12) has moderate to severe edema of the palpebrae and periocular area, especially if accompanied by a mucopurulent nasal or ocular discharge and signs of chronic discharge on forelimbs, eyes, and beak. Salvage is inappropriate solely when a limb is lost from a predator attack, because some tortoises recover and function quite well in the wild. The monitoring of individual tortoises and environmental conditions will help to determine the cause and severity of some clinical signs of disease. For example, weight loss can be an early sign of disease (Jackson, 1980; Oettle et al., 1990), as well as a normal response to drought, hibernation, and estivation (Peterson, 1996a, b; Henen, 1997).

Subtle behaviors can provide evidence of illness and justification for salvage. Each of the lethargic and inactive tortoises and some of the alert and active tortoises (Table 2) provided one or more additional behavioral clues of their status for several weeks or months prior to death: they were active and above ground at inappropriate times of year, failed to emerge or were late (several weeks or months) in emerging from hibernation, failed to return to burrows and typical sleeping places at night or during hot times of day (see also Oettle et al., 1990), remained in a resting position in one place day after day, and failed to eat when forage was readily available or failed to drink during a warm rain.

Decisions about salvage, whether for a specific research project or because the tortoise may have reached a "point of no return" can be difficult. An animal can only be evaluated in the field up to a point; without a necropsy there is no total certainty about physical status. Difficult cases may be resolved through a team effort between the wildlife health specialist, research veterinarian, and field biologist using a cell phone from the field (a requirement now for our field staff) or a visit to the field. No substitutes exist for experience, good judgment and common sense, however.

SUMMARY

Health assessments of wild animals are becoming more common, and often include blood sampling, complete blood counts and biochemical profiles, as well as analyses for vitamins, minerals, and organochemical compounds (e.g., Calle et al., 1994; Dunlap, 1995; Christopher et al., 1999). We recommend that the health assessments described herein become required and standard guidelines for prescreening any animal to be used in a research project, whether the research project is conducted by veterinarians, herpetologists, ecologists, or zoologists. Historically, most researchers have assumed that wild chelonians were healthy without evaluating clinical signs of disease or conducting lab tests. If research animals were ill and the information was not included in methods or results, the results and interpretations may be erroneous. Health assessments are also essential for any chelonian breeding program, as well as translocation, relocation, or repatriation programs (Jacobson, 1993, 1994a, 1994b; Cunningham, 1996).

The evaluation of clinical signs will be most reliable and effective when the clinician or field biologist has a broad knowledge of the wild animal's normal and abnormal appearance, postures, and behaviors by season and region, and a great deal of field experience. Field personnel are likely to be more reliable and consistent observers after viewing hundreds of animals with a wide range of conditions. When the species in question is rare, threatened, or endangered, field sample sizes are usually limited. In such cases the field team may gain experience using dozens of ill and healthy captive tortoises. Field personnel should also take precautions to prevent transmission of pathogens (e.g., Ahne, 1993; Cunningham 1996) from one individual animal to another and from one population to another.

Field personnel, wildlife health specialists, and veterinarians can use the data obtained through these methods to develop comprehensive databases on clinical and behavioral signs of health and disease for desert tortoises or other species. Clinical and behavioral signs should be quantified using consistent methodologies, and the relationships between clinical signs, behavioral data, and laboratory data compared. New statistical procedures are available to study links between behavioral characteristics and disease (e.g., Escós et al., 1995).

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APPENDIX 1. Supplemental system for grading the beak, nares, eyes, and chin glands of desert tortoises. Instructions: depending on subject, circle one or more options. Rating system: 1 = normal, 2 = mild, 3 = moderate, 4 = severe.

BEAK & NARES

Site and variables	Presence of moisture	Severity (rate 1–4)	Color and notes
Beak	dry/damp/wet	________	no foraging evident vs. recent foraging evident (green beak, sap, etc.)
Right Nare	dry/damp/wet	________	
Left Nare	dry/damp/wet	________	
Exudate present	no/yes		
Right Nare	none/dried/wet	________	N = none, C = clear, Co = cloudy W = white, Y = yellow, G = green
Left Nare	none/dried/wet	________	
Bubble(s) from Nares			
Right Nare	no/yes	________	
Left Nare	no/yes	________	

Site	Degree of occlusion of nares Nares occluded
Right Nare	no/partial/complete
Left Nare	no/partial/complete

	Presence of dirt	Amount/Severity (rate 1–4)
Dirt on beak	no/yes	________
Dirt on/in		
Right Nare	no/yes	________
Left Nare	no/yes	________

EYES: Palpebrae Area, Globe

Variable	Presence	Severity (rate 1–4)	Location
Condition of Globe			
Right Eye	yes/no	________	clear/bright/mucus present/dull/cloudy
Left Eye	yes/no	________	clear/bright/mucus present/dull/cloudy
Other obvious lesions			
Right Eye	yes/no	________	corneal ulcers/cornel abrasions
Left Eye	yes/no	________	corneal ulcers/corneal abrasions
Discoloration of globe			
Right Eye	no/yes	________	Color and location: ________
Left Eye	no/yes	________	Color and location: ________
Edema of palpebrae			
Right Eye	no/yes/unknown	________	upper palpebra/lower palpebra
Left Eye	no/yes/unknown	________	upper palpebra/lower palpebra
Edema of periocular area			
Right Eye	no/yes/unknown	________	upper periocular area/lower periocular area
Left Eye	no/yes/unknown	________	upper periocular area/lower periocular area
Discharge from Eye			
Right Eye	none/wet/dried	________	
Left Eye	none/wet/dried	________	
Crusts on palpebrae and periocular area			
Right Eye	no/yes	________	upper palpebra/lower palpebra
Left Eye	no/yes	________	upper palpebra/lower palpebra
Other lesions of the palpebrae and periocular area			
Right Eye	no/yes	________	trauma, necrosis: palpebra/periocular area
Left Eye	no/yes	________	trauma, necrosis: palpebra/periocular area

Appendix 1. Continued.

Degree of Closure of Palpebra				
Right Eye	normal (100% open)/partially closed (____ %)			
Left Eye	normal (100% open)/partially closed (____ %)			
Sunken/Recessed Eyes				
Right Eye	no/yes/unknown	________		
Left Eye	no/yes/unknown	________		
Eye Swollen or Bulging in Appearance				
Right Eye	no/yes/unknown	________	dorsal/lateral	
Left Eye	no/yes/unknown	________	dorsal/lateral	

CHIN GLANDS

Site	Size	Drainage	Severity	Color of Drainage
Right Gland	normal/swollen	present/absent	________	none/clear/cloudy/white yellow/green
Left Gland	normal/swollen	present/absent	________	

POSTURE/BEHAVIOR			
Behavior appropriate for time of day	yes/no	If no, describe	________
Behavior appropriate for season	yes/no	If no, describe	________
FORELIMBS			
Right	normal/abnormal	If abnormal, describe:	________
Left	normal/abnormal	If abnormal, describe:	________
HINDLIMBS			
Right	normal/abnormal	If abnormal, describe:	________
Left	normal/abnormal	If abnormal, describe:	________
OTHER			
Tail	normal/abnormal	If abnormal, describe:	________
	normal/abnormal	If abnormal, describe:	________

Calico Solar – 08-AFC-13
DECLARATION OF SERVICE

I, Bonnie Heeley, declare that on August 17, 2010, I served and filed copies of the attached EXHIBITS 443-453, dated August 17, 2010. The original document, filed with the Docket Unit, is accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at www.energy.ca.gov/sitingcases/calicosolar/CalicoSolar_POS.pdf. The document has been sent to both the other parties in this proceeding as shown on the Proof of Service list and to the Commission's Docket Unit electronically to all email addresses on the Proof of Service list; and by depositing in the U.S. mail at South San Francisco, CA, with first-class postage thereon fully prepaid and addressed as provided on the Proof of Service list to those addresses NOT marked "email preferred."

AND

By sending an original paper copy and one electronic copy, mailed and emailed respectively to:

CALIFORNIA ENERGY COMMISSION
Attn: Docket No. 08-AFC-13
1516 Ninth Street, MS 4
Sacramento, CA 95814-5512
docket@energy.state.us.ca.

I declare under penalty of perjury that the foregoing is true and correct. Executed at South San Francisco, CA, on August 17, 2010

/s/
Bonnie Heeley

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