SIERRA CLUB
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August 23, 2010

California Energy Commission
Attn: Paul Kramer, Hearing Officer
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512

Re: **Ivanpah Solar Electric Generating System, Docket No. 07-AFC- 5**

Dear Mr. Kramer,

Please find enclosed for filing the original of Intervenor Sierra Club's Supplemental Exhibits. If you have any questions or need additional information, please contact me at (415) 977-5766 or violet.lehrer@sierraclub.org. Thank you for your attention to this matter.

Sincerely,

Violet Lehrer

Violet Lehrer
Program Assistant
Sierra Club Environmental Law Program
85 Second Street, 2nd Floor
San Francisco, CA 94105

STATE OF CALIFORNIA

Energy Resources Conservation and Development Commission

In the Matter of:	)	
	)	
The Application for Certification	)	
for the	)	Docket No. 07-AFC-5
IVANPAH SOLAR ELECTRIC	)	
GENERATING SYSTEM	)	
______________________________	)	

INTERVENOR SIERRA CLUB'S SUPPLEMENTAL EXHIBITS

August 23, 2010

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INTERVENOR SIERRA CLUB'S SUPPLEMENTAL EXHIBITS

Intervenor Sierra Club provides the following supplemental exhibits and updated list of exhibits pursuant to the Notice of Evidentiary Hearing issued August 3, 2010.

UPDATED LIST OF EXHIBITS

Exhibit No.	Author and Title
613	Gowan T, KH Berry. 2009. Progress Report for 2009: The Health Status of Translocated Desert Tortoises (*Gopherus agassizii*) in the Fort Irwin Translocation Area and Surrounding Release Plots, San Bernardino County, California: Year 2. U.S Geological Survey, Western Ecological Resource Center.
614	KH Berry et al. 2009. Progress Report for 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. U.S. Geological Survey, Western Ecological Resource Center
615	Email from Kristin H. Berry to Clarence A. Everly, Roy Averill-Murray, and Beck Jones regarding Dead and Missing tortoises, Health research project. April 29, 2009.
616	Dodd CK Jr., RA Seigel. 1991. Relocation, Repatriation, and Translocation of Amphibians and Reptiles: Are they Conservation Strategies that Work? Point of View: A Controversy in Conservation Biology. pp. 336-350.
617	Germano JM, PJ Bishop. 2008. Suitability of Amphibians and Reptiles for Translocation. *Conservation Biology*, Volume 23, No. 1, 7–15

Dated: August 23, 2010

Respectfully submitted,

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EXHIBIT 613

PROGRESS REPORT FOR 2009

The Health Status of Translocated Desert Tortoises (*Gopherus agassizii*) in the Fort Irwin Translocation Area and Surrounding Release Plots, San Bernardino County, California: Year 2

Timothy Gowan and Kristin H. Berry (Principal Investigator)
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for

Commander National Training Center and Fort Irwin
ATTN: AFZJ-PW-EV, Mr. Clarence Everly
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The Health Status of Translocated Desert Tortoises (*Gopherus agassizii*) in the Fort Irwin Translocation Area and Surrounding Release Plots, San Bernardino County, California

Abstract. In spring of 2008, we translocated 158 adult and subadult tortoises (82 females and 76 males) from the Southern Expansion Area (SEA) to four plots located in the Superior-Cronese Desert Wildlife Management Area (DWMA) as part of the Desert Tortoise Health and Disease Research Project for the Ft. Irwin Expansion. Long-term objectives 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. Tortoises were placed in 4 health categories: 1) healthy or control tortoises, 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 but with no evidence of nasal discharge and negative laboratory tests.

As of December 2008, 43 of the initial 158 translocated tortoises had been found dead or had been salvaged for necropsy, and an additional 15 tortoises were missing. We started Year 2 in January 2009, with 100 live tortoises and 15 missing tortoises in the project. During 2009, we 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 4 (4.9%) and 2 (2.5%) tortoises had positive or suspect ELISA tests for *Mycoplasma agassizii* and *M. testudineum,* respectively. 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.

Between January and December of 2009, 27 (23.5%) of the remaining 115 live and missing tortoises were found dead. Of the 27, 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. Combining data from 2008 and 2009, death rates were significantly higher on two plots, plots 3 and 5, than on plots 1.5 and 8. In contrast to 2008, in 2009 the size of a tortoise was not related to risk of death; the average carapace length did not differ from those still alive. Likewise, in contrast to 2008, in 2009 death rates did not differ between sexes. Death rates also did not differ significantly among the four health categories. At the end of 2009, an additional 20 tortoises (17.4%, 20/115) were missing.

We analyzed movement patterns for live tortoises between the time of initial release in spring 2008 and December 2009 (N = 68). Overall, the mean dispersal distance for males was twice that of females; likewise, males moved twice the total distances compared to females. Total distances moved were higher on plots 3 and 5 than

on plots 1.5 and 8 but were not significantly different. However, the minimum total distances moved in 2009 were significantly less than in 2008. Females were more likely to use the same cover sites between 2008 and 2009 than males, a potential indication of settling.

INTRODUCTION

The desert tortoise (*Gopherus agassizii*) is a Federally- and State-listed threatened species. Critical habitat for the species occurs north and west of the Colorado River/Grand Canyon complex, including habitat on and adjacent to the National Training Center, Ft. Irwin, in the central Mojave Desert (U.S. Fish and Wildlife Service 1990, 1994). As part of the Ft. Irwin Translocation Project, an estimated 600 to 1000 tortoises have been or are planned to be translocated from the southern and western parts of the expanded Ft. Irwin base to areas outside the Ft. Irwin boundary (Esque et al. 2005).

The primary goal of this research project is to monitor the health and disease status of the translocated tortoises, with an emphasis on the spread of infectious disease. Because infectious diseases have been linked to declining desert tortoise populations (Jacobson et al. 1991; Brown et al. 1994, 1999; Homer et al. 1998; Christopher et al. 2003), the incidence of disease is a critical factor in determining success of translocation. We designed our project to measure the success of translocation, depending on health status of translocated tortoises. Specifically, the translocated tortoises were grouped into one of four health categories: 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 no evidence of nasal discharge and negative laboratory tests.

Several long-term objectives are to be addressed during the life of the multi-year project. First, we are tracking and sampling tortoises for several years to model and predict the effects of translocation on survival by health status, size and age class, and sex. More specifically, we hope to determine 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 post-translocation. To better understand the epidemiology and distribution of mycoplasmosis or URTD in the Ft. Irwin Translocation Project area, the health status of tortoises and locations of tortoises that have previously tested positive or suspect for mycoplasmosis are being continuously monitored. As part of these analyses, we are also examining differences in survivorship and causes of death among health status categories; differences in survivorship among size and age classes, sexes, and translocation release sites; and differences in the pathogenesis of mycoplasmosis among size and age classes, sexes, and levels of anthropogenic impacts.

Second, the anthropogenic factors most likely to influence translocation success need to be identified and modeled. Anthropogenic factors include but are not limited to roads, military maneuver areas, and rural or urban areas. Third, ecological factors, including landscape and topography, are other variables in the analysis. Both anthropogenic and ecological factors have the potential of affecting health status and degree of trauma of translocated tortoises. We will also explore differences in survivorship among size and age classes and sexes by comparing habitat conditions between initial capture sites and translocation release sites, including levels of anthropogenic disturbance at original home sites and release sites.

This report is a progress report summarizing the status of 158 tortoises that were translocated in the spring of 2008 and were subsequently monitored for health and disease (Berry et al. 2009). Briefly, in spring of 2008, a total of 82 females and 76 males were translocated from the Southern Expansion Area (SEA) to four plots located in the Superior-Cronese Desert Wildlife Management Area (DWMA). As of December 2008, 43 of the initial 158 translocated tortoises had been found dead (41) or salvaged for necropsy (2), and an additional 15 tortoises were unable to be located and were considered missing. We started the 2009 field season in January with 100 remaining tortoises. In addressing the previously stated objectives, we tracked the remaining translocated tortoises monthly, continued to search for missing tortoises, conducted health evaluations on the tortoises during spring and fall, analyzed movement patterns and use of cover sites, and determined causes of death for dead individuals. Our preliminary findings for 2009 are summarized below.

METHODS

Translocation

Between March 26 and April 8, 2008, 158 desert tortoises were translocated from the SEA to one of four designated plots (plots 1.5, 3, 5, and 8; see Fig. 1). These translocation plots, each about one square mile in size, are located outside the Ft. Irwin boundary and are within or bordering the Superior-Cronese DWMA. Prior to translocation, tortoises located in the SEA were fitted with radiotransmitters and were assigned to one of the following four health status categories based on previous health evaluations: 1) healthy 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 URTD, but with no evidence of nasal discharge and negative laboratory tests. Approximately 20 adult males and 20 adult females in each of the four health status categories were selected to be translocated (Berry et al. 2009). Tortoises that had previously tested positive for mycoplasmosis or had signs of nasal discharge were not considered for translocation.

Tortoises were tracked daily, then weekly, and finally at least once per month after translocation using radio telemetry (Berry et al. 2009). Beginning in July 2008, all translocated tortoises were tracked on a monthly basis, unless behavioral or health reasons dictated more frequent checks. Upon locating tortoises during monthly tracking, critical data were recorded, including, but not limited to: date, weather conditions, time observed, location in UTMs (NAD 83), behavioral observations, specific location of the tortoise (e.g., inside cover site, in open, under shrub), interactions with other tortoises, and general condition of the tortoise (e.g. appearing ill, stressed, lethargic, or healthy). When tortoises were located and found to be dead, the location, position, and condition of remains, along with evidence for cause of death were recorded and the remains were photographed.

Health Evaluations

Periodically, comprehensive health evaluations of each tortoise were conducted. In general, the health status of each tortoise was evaluated once in the spring (April 27 to May 4) and once in the fall (October 7 to October 27) in 2009, but these evaluations were more frequent for tortoises showing indications of illness or stress. The evaluations included recording data regarding posture, behavior, activity, recent trauma, and clinical signs of disease, such as URTD and cutaneous dyskeratosis, on the eyes, beak, nares, integument, and shell on a standardized seven-page form modified from an appendix in Berry and Christopher (2001). Length at the carapace midline (MCL) and weight of each tortoise were measured during evaluations, and digital photographs were taken of the eyes, beak, nares, plastron, carapace, and any unusual trauma or lesions. Blood and nasal lavage samples were also collected during health evaluations.

Samples of blood were drawn either by brachial venipuncture or from the subcarapacial site using standard protocols (Hernandez-Divers et al. 2002, Berry et al. 2006). Samples of blood that contained 15% or more of lymph were considered to be suboptimal because of the potential negative impact of dilution (e.g., Gottdenker and Jacobson 1995). Where possible, such samples were repeated with an objective of obtaining 90–100% blood with no lymph or only a trace of lymph (Berry et al. 2005). A nasal lavage was taken using standard protocols (Berry et al. 2006). Blood plasma and nasal samples were shipped to the Mycoplasma Laboratory at the University of Florida to determine the presence of antibodies to *Mycoplasma agassizii* or *M. testudineum* using enzyme-linked immunoassay (ELISA) tests (Schumacher et al. 1993; Brown et al. 1994, 2004; Wendland et al. 2007). Cultures and polymerase chain reaction tests (Brown et al. 2002) were also used. The laboratory procedures are summarized in Berry (2006).

Three primary databases were constructed for each calendar year. One database is the monthly monitoring with dates and locations in UTMs. The second database summarizes tissue samples obtained and includes data on type of samples obtained (blood plasma, plasma/lymph, and nasal lavage), date of collection, volume of samples, results of ELISA tests for *M. agassizii* and *M. testudineum*, and results of polymerase chain reaction tests for positive or suspect cultures. The first two databases are being transmitted separately to Clarence Everly, permit holder, for the federal U.S. Fish and Wildlife Service permit. They contain all Ft. Irwin-related data sets. The third database contains the data collected from health evaluations, including clinical signs of disease and trauma. This database is still in the process of receiving quality assurance and control and will be provided at a later time.

Movement Patterns

Two variables relating to movement patterns were calculated for the translocated tortoises. The first variable, dispersal distance, was calculated as the straight-line distance between the point of release and the location furthest from the release point at which the tortoise was located. The second variable, minimum total distance, was calculated as the summation of the straight-line distances between consecutive locations. Both of these measurements were calculated with straight-line distances and, as such, should be considered conservative estimates. Only live tortoises with known locations (i.e., those not dead or missing) as of December 2009 were used in these analyses (n = 68).

To determine the degree of settlement of translocated tortoises, the minimum total distance moved in 2008 was compared to that in 2009 for the 68 tortoises described above. Fidelity to cover sites was also examined (n = 68) by comparing summer (July and August) and winter (December and January) cover site locations for 2008 and 2009. The distance moved each month by these 68 tortoises was also plotted to examine seasonal and annual variation in movements patterns and differences between sexes. Finally, the number of tortoises still remaining on each plot (i.e. within the one square mile boundary of the initial release plots) was compared to the number of tortoises that have dispersed from the plot.

Data Analysis

We used repeated measures ANOVA to examine changes in weight within individual tortoises across seasons after translocation. A post hoc test was used to determine which seasons differed. Only tortoises with weight data for all four seasons (spring 2008, fall 2008, spring 2009, and fall 2009) were used in this analysis (n = 64).

One-way ANOVAs were used to compare movement variables (dispersal distance and minimum total distance) between sexes and among plots. A paired t-test was used to compare minimum total distances between 2008 and 2009. Because tortoises were released at translocation sites in March-early April 2008, we analyzed and compared movements from March-December of 2008 with movements from March-December 2009.

Fisher’s exact tests were used to compare cover site fidelity between sexes, as well as death rates between translocation plots, between sexes, and between health categories (healthy, shell disease, URTD, or trauma). Fisher’s exact tests were also used to compare the proportion of tortoises still remaining within plot boundaries among translocation sites and among sexes. One-way ANOVAs were used to compare the sizes (MCL) of tortoises that died to those still alive. All statistical tests were conducting using SYSTAT Software version 12.0 (SYSTAT Software Inc. 2007).

RESULTS

Summary of 2008

A total of 82 females and 76 males were translocated from the SEA to plots located in the DWMA. Of the 158 translocated tortoises, 21 females and 17 males were translocated to Plot 1.5, 21 females and 19 males were translocated to Plot 3, 19 females and 20 males were translocated to Plot 5, and 21 females and 20 males were translocated to Plot 8. As of December 2008, 43 of the initial 158 translocated tortoises were found dead (41) or salvaged for necropsy (2), and an additional 15 tortoises were unable to be located at the time and were considered missing. As of December 2008, the locations of 100 live tortoises were known. The sex ratio of these tortoises was 44 females and 56 males.

Health Evaluations

In January 2009, 44 females and 56 males were known to be alive; in December 2009, 32 females and 36 males were known to be alive. Comprehensive health evaluations were conducted on 81 translocated tortoises in the spring of 2009 (April 27 to May 4). Blood plasma and nasal lavage samples were also collected from each of these 81 tortoises. Three of these blood samples (3.7%) were a blood/lymph mixture, with at least 90% of the sample composed of blood; the remaining samples were composed of 100% blood. As of the end of spring of 2009, 55 tortoises had been found dead or salvaged for necropsy and 22 were unable to be located.

Comprehensive health evaluations were conducted on 65 translocated tortoises in the fall of 2009 (October 7 to October 27). Blood plasma and nasal lavage samples were also collected from each of these 65 tortoises. Eight of these blood samples were a blood/lymph mixture, with at least 95% of the sample composed of blood; one sample (from 4499F) was a blood/lymph mixture with 50% of the sample composed of blood; the remaining samples were composed of 100% blood. As of the fall of 2009, 69 tortoises had been found dead or salvaged for necropsy, 20 were unable to be located, and four were unable to be extracted from their cover sites for health evaluations.

Tests for Mycoplasmosis

In the spring of 2009, four (4.9%) of 81 tortoises had positive or suspect ELISA tests for *Mycoplasma agassizii* (Table 1). Three tortoises had suspect tests and one tortoise had a positive ELISA test for *M. agassizii*. Of the four tortoises with positive or suspect ELISA tests for *M. agassizii*, two were located on plot 8, one was on plot 1.5, and one was on plot 3 (Fig. 2). Additionally, two tortoises (2.5%) had positive or suspect ELISA tests for *M. testudineum*. One tortoise had a positive test and the other a suspect ELISA test for *M. testudineum*; both were located on plot 1.5 (Fig. 3). Of the 81 nasal lavage samples collected in the spring, all cultures were negative for both *M. agassizii* and *M. testudineum*.

In the fall of 2009, six (9.2%) of 65 tortoises tested for *M. agassizii* had positive or suspect ELISA tests (Table 1). Three tortoises had positive tests and three tortoises had suspect ELISA tests for *M. agassizii*. All six tortoises were located on plots 1.5 or 8 (Fig. 4). Five of these tortoises had previous positive or suspect tests for mycoplasmosis (Table 1). All 65 tortoises tested for *M. testudineum* in the fall had negative ELISA tests (Fig. 5). Two tortoises (4024M and 4257F) which had previously tested positive and suspect, respectively, for *M. testudineum* in spring, were not available to be tested because they had been killed by predators. Results are not yet available for cultures from the 65 nasal lavage samples.

Weight

There was a significant effect of season on measured weight ($F_{3,189} = 132.0$, $p < 0.001$). The post-hoc test revealed weight was greatest in spring 2008 just after translocation, fell in fall 2008, increased back to initial levels in spring 2009, and fell again in fall 2009 (Fig. 6). Weight was not significantly different among the two spring seasons ($p = 0.964$), however it was significantly lower in fall 2009 compared to fall 2008 ($p = 0.001$).

Movements and Fidelity to Cover Sites

Summary statistics for dispersal distance and minimum total distance are reported in Table 2. The tortoise which has moved the most, 4143M translocated to plot 8, has been located on multiple dates just outside the Ft. Irwin boundary fence in the SEA, 12.6 km from its initial release location, and has moved a total distance of at least 18.8 km since its release. Overall, males have dispersed further from their release locations compared to females (means = 3256.4 m for males, 1517.9 m for females; $F_{1, 66} = 12.3$, $p = 0.001$). Males also had greater total distances moved compared to females (means = 6858.4 m for males, 3492.0 m for females; $F_{1, 66} = 23.9$, $p < 0.001$). Although the total distances that remaining live tortoises moved was greater on plots 5 (mean = 7403.3 m) and 3 (6020.8 m) compared to plots 1.5 (4899.8 m) and 8 (4778.4 m), these differences were not statistically significant ($F_{3, 64} = 1.5$, $p = 0.224$). Similarly, dispersal distance did not vary among translocations plots ($F_{3, 64} = 1.1$, $p = 0.351$).

The minimum total distance moved in 2009 (mean = 1854 m) was significantly less than that in 2008 (mean = 3222 m; $t_{67} = 4.837$, $p < 0.001$). Regarding use of cover sites, five of 68 (7.4%) tortoises have used the same cover site every season (summer and winter of 2008 and summer and winter of 2009), and an additional 36 (52.9%) tortoises have used the same cover site in at least two of these seasons. In contrast, 27 (39.7%) of 68 tortoises had minimal fidelity to sites and used a different cover site for each season examined. Females were more likely to use the same cover sites than males (Fisher's exact test, $p < 0.001$); 22 of 38 males used different cover sites for each season compared to just 5 of 30 females.

Eighteen tortoises still remain within the boundaries of their initial release plots. On plot 1.5, six tortoises still remain on the plot, compared to two on plot 3, one on plot 5, and nine on plot 8 (Table 3). However, when considering the total number of tortoises alive at each translocation site, the proportion of tortoises on plot to those off plot is not significantly different among translocation plots (Fisher's exact test, p = 0.801). Additionally, the number of females remaining on the plots does not differ from the number of males (Fisher's exact test, p = 1.00).

There has been marked seasonal variation in movement. Tortoises moved the greatest distances in the spring months immediately following translocation (Fig. 7). Tortoises travelled large distances in the spring of 2009 and, to a lesser extent, in the fall seasons of 2008 and 2009. Tortoises were least active during summer and winter months. The distances moved in 2009 were noticeably less than those in 2008 for both the spring and fall seasons, respectively (Fig. 7). Corroborative with the previous analyses, in general males moved more than females in each month.

Mortality

As of December 2009, 70 (44.3%) of the initial 158 tortoises had been found dead (68) or had been salvaged for necropsy (2). For 2009, the death rate of the 115 remaining tortoises (27 of 115), was similar (23.5%) but slightly lower than that of 2008, the year in which tortoises were first translocated (43 of 158, 27.2%). In 2009, 24 tortoises were probably killed by coyotes or other canids, and the causes of death were unable to be conclusively determined for three tortoises (Table 4). One of these tortoises, 4644F, had been missing for six months before its remains were located. When located, the carcass was crushed, the head and limbs were still remaining and intact, and there were no obvious signs of scavenging or predation (tooth marks, gnashes, tears). A relatively well-used, Bureau of Land Management-designated dirt road was approximately 300 m from where the carcass was located. The most likely cause of death, based on the condition of remains, was crushing by a vehicle. The tortoise was probably transported to the site by a person to conceal the death. The other two tortoises, 4548F and 4441M, were found dead in the open, with no evidence of predation; the head and limbs were still intact. Both tortoises moved large distances during the summer months prior to their deaths, and the expenditures of energy may have contributed to the causes of death.

Combining data for both sexes and both years, death rates varied significantly among translocation plots (Fisher's exact test, p < 0.001); 12 of the tortoises that died were located on plot 1.5, 24 were located on plot 3, 26 were located on plot 5, and eight were located on plot 8. More dead tortoises were females (42) than males (28), but the difference was not statistically significant (Fisher's exact test, p = 0.126). Death rates did not differ among health categories (i.e. groups to which tortoises were assigned prior to translocation; Fisher's exact test, p = 0.7918); 21 tortoises with clinical signs of shell disease died, followed by 17 tortoises with clinical signs of trauma, 16 healthy tortoises, and 16 tortoises with clinical signs of URTD. The size of a tortoise was not related to risk of death, as the average carapace length of tortoises that died did not differ from those still alive ($F_{1,137}$ = 1.719, p = 0.192). However, tortoises that died in 2009 were larger than those that died in 2008 (mean MCL ± SE = 246.5 ± 4.7 mm vs. 231.7 ± 3.7; $F_{1,68}$ =6.05, p = 0.016). Males were driving the statistical difference between years. Males dying in 2009 were significantly larger than those dying in 2008 (MCL = 262.5 ± 7.5 mm vs. 226.3 ± 8.1 mm; $F_{1,26}$ = 10.67, p = 0.003), whereas sizes of females were not significantly different between years (MCL = 226.5 ± 4.5 mm in 2009 vs. 234.0 ± 2.8 mm in 2008; $F_{1,40} = 1.98$, $p = 0.167$).

For data from 2009 alone, there was a significant effect of translocation plot on death rates (Fisher's exact test, $p = 0.005$; see Table 4), with again the highest rates on plots 3 and 5. Seven of the remaining 32 tortoises on plot 1.5 died in 2009, compared to six of the remaining 16 on plot 3, ten of the remaining 15 on plot 5, and four of the remaining 31 on plot 8. In 2009 alone, there was no difference in death rates among the sexes (Fisher's exact test, $p = 0.501$); 11 of the remaining 45 females died compared to 16 of the 51 remaining males.

Three of the 43 tortoises found dead in 2008 (4014F, 4720F, 4011F) previously had suspect ELISA tests for mycoplasmosis. In 2009, eleven of the 27 tortoises found dead had previous positive or suspect tests for *M. testudineum* (2533M positive in spring 2009; 4024M suspect in spring 2009; 4136F, 2023M, 2557F, 4179F, 4644F, 4085F, 4106M, 4361M, and 4442M suspect in fall 2008). Several of these tortoises had suspect ELISA tests for *M. testudineum* from fall 2008, a season with an unexpectedly high number of suspect tests for this species (Berry et al. 2009).

Of the initial 158 translocated tortoises, 20 tortoises (17.4%, 20/115) were unable to be located in December 2009 and are considered missing. Of the 20 currently missing tortoises, six had their radiotransmitters detached by a predator or otherwise, and the radiotransmitter signals of the remaining 14 are inaudible at previously known locations. As of December 2009, the locations of 68 live tortoises were known. The sex ratio of these tortoises (32 females and 36 males) is not significantly different than the sex ratio in December 2008 ($X^2 = 0.05$, df = 1, $p = 0.82$).

DISCUSSION

The results for the second year of the SEA translocation project reveal that the death rate of translocated tortoises is still high. In January 2009, 115 tortoises were known to be alive or missing. By the end of 2009, 23.5% of the tortoises had died and an additional 17.4% either remained missing or were newly missing. Overall, in December 2009, 40.9% had either been found dead or were still missing. Combining the data from 2008 and 2009, from the time of initial translocation of 158 tortoises in March-April of 2008, 70 (44.3%) tortoises have died and an additional 20 (12.7%) are missing.

As in the first year, predation by coyote continues to be the primary cause of deaths (Table 4). Overall, death rates were highest in the months immediately following translocation in 2008 and in the spring and fall of 2009 (Fig. 8). These time frames correspond to when tortoises were active and spending more time above-ground (i.e., just after translocation to a novel location, foraging in spring, and seeking mating opportunities in late summer/fall; see Fig. 7). Correspondingly, death rates were lowest in the winter of 2008 and summer of 2009 when tortoises spent more time in well-developed cover sites. While death rates were higher among females and smaller tortoises in 2008 (Berry et al. 2009), this was not the case in 2009. There is an apparent trend that predation was initially highest among small females, but now larger males are also targets of predation (Fig. 9). This pattern may be an artifact of fewer females on the study plots after the initial wave of predation, or it may signify that coyotes have increased their abilities to successfully prey upon the larger male tortoises.

Disease may be an important factor in predation. A substantial portion of the tortoises that died in 2009 (40.7%) had previously tested positive or suspect for mycoplasmosis after being translocated. This figure includes all tortoises in the project, regardless of health group. We need to conduct further research and analysis on effects of health and disease on survival.

Between 2008 and 2009, the proportion of tortoises with suspect or positive ELISA tests increased for *M. agassizii* but decreased for *M. testudineum*. In the spring and fall of 2009, 4.9% and 9.2% of tortoises had positive or suspect ELISA tests for *M. agassizii*. These proportions of ELISA suspect and positive tortoises for *M agassizii* are higher than in 2008 (Berry et al. 2009) and higher than reported for 669 tortoises sampled in and around the SEA in 2007 (Berry and Mack 2008). Similar to findings in 2008 (Berry et al. 2009), tortoises with positive or suspect tests for *M. agassizii* are concentrated on or near plots 1.5 and 8 (Figs. 2 and 4). Three individuals had multiple positive or suspect tests for *M agassizii* during 2008 and 2009 (Table 1).

In the spring of 2009, two tortoises (2.5%) had positive or suspect ELISA tests for *M. testudineum*. These two tortoises were killed by predators during summer and thus could not be sampled in fall. All remaining tortoises had negative tests for *M. testudineum* in the fall. While the proportion of tortoises with positive or suspect tests in spring of 2008 and 2009 are similar, there is a notable discrepancy when comparing rates from the fall seasons of the same years, 31.5% in 2008 vs. 0% in 2009 (Berry et al. 2009). Shifts from positive or suspect ELISA tests for *M. testudineum* to negative status may be due to the quality of blood samples and dilution with lymph, the virulence of *Mycoplasma* spp., timing of sampling in fall, variations in the tests, or other factors.

Weight can be an important indicator of overall health (Henen et al. 1998; Christopher et al. 1999, 2003; Berry et al. 2002). Weight may reflect hydration status, expenditures of energy, availability of food and water, ability of a tortoise to find food and water, and health status. The seasonal differences in weight between spring, summer, and fall observed in the SEA tortoises are comparable to previous studies of desert tortoise populations; weight is generally higher in the spring than in fall (Christopher et al. 1999). However, the decrease in weight between the 2008 and 2009 fall seasons is of concern, and weight should continue to be monitored in conjunction with health assessments or more frequently.

The data on movement patterns of translocated tortoises will be useful for determining the appropriate size for future translocation release sites, the effects of translocation on behavior, and potentially, the effects of habitat type and quality on behavior. Our preliminary results show that translocated tortoises may disperse up to 13 km from their release location within the first two years. Therefore future managers and scientists responsible for designing and managing translocations should consider translocation sites with a buffer zone of suitable habitat at least this large in each direction. Additionally, only 18 of the initial 158 tortoises have not dispersed from the one square mile release plots, indicating the need for translocation sites with much larger areas of quality habitat. In some regards, the translocated tortoises in this study have exhibited movement patterns similar to those reported in previous studies. Differences exist between sexes, with males moving more than females (Berry 1986, O'Connor et al. 1994), and differences exist between seasons, with higher activity levels in the spring and fall compared to the summer and winter when temperature extremes and/or lack of water limit above ground activity (see Fig. 7; Henen 1997, Henen et al. 1998, Nagy and Medica 1986). Tortoises moved less in 2009 compared to 2008, the year in which tortoises were first translocated, and some tortoises have repeatedly used the same cover sites. These results suggest that some translocated tortoises have begun to "settle" into the new sites and may be establishing home ranges, a first step in assimilating with the resident population. Also of note is that movements were greater (statistically in 2008 [Berry et al. 2009], but not for both years combined) on plots 3 and 5 compared to plots 1.5 and 8. Plots 3 and 5 also had higher death rates, and the possible relationship between increased movement and risk of mortality deserves further attention.

Continued work on this project will be directed at addressing the previously stated objectives. Health, including prevalence of mycoplasmosis and other diseases, weight, and general condition, of translocated tortoises will continue to be monitored at regular intervals by incorporating clinical signs of disease recorded during health evaluations with ELSIA test results. Signs of trauma and shell disease, along with signs of URTD, will be analyzed to determine the effects of translocation and anthropogenic impacts on these variables and whether or not incidences of disease and trauma have increased since translocation. The survival and movement patterns of translocated tortoises will continue to be monitored to assess the success of translocation. Finally, habitat characteristics, including topography, foraging and cover site availability, and levels of anthropogenic impacts, will be compared between initial capture sites and translocation release sites as well as among the four translocation plots.

RECOMMENDATIONS

1. This report does not contain a complete analysis of all health data for the translocated tortoises, between the time of translocation and December 2009, e.g., the analysis of changes in clinical signs between seasons and years. This analysis will be conducted as time permits.

2. The abnormally high death rates that began shortly after the initial translocation in March and April of 2008 have continued, and have again risen to high levels in the fall of 2009. The high death rates are primarily the result of canid (coyote) predation. The result has been loss of a significant portion of the sample population. Scientists have reported high death rates of tortoises from predators in other Ft. Irwin studies and in other research projects in California and Nevada during the last few years, and have summarized findings in a draft manuscript for the open literature (Esque et al.,

unpublished paper). Little or no action has been taken (depending on the site) by managing agencies to mitigate the impact to tortoise populations. In our study, which is in critical habitat, we designed the health and disease project to provide valuable information for recovery efforts and to mitigate some impacts of the translocation. Unfortunately, the high death rates have compromised the quality and quantity of data, as well as our ability to achieve many of the initial research objectives. Many elements of the research project will need to be repeated in future translocation efforts using a more robust sample if we are to achieve our initial goals.

3. Based on the unpublished manuscript by Esque et al. on predation, the high death rate from translocatees appears to be influenced by proximity to urban/rural areas and topographical features. There may be other local factors that contribute to elevated populations of coyotes and other predators of tortoises, including proximity to old agricultural fields, roads, trails, and recreation. The younger and smaller subadult and adult tortoises are probably more vulnerable than larger, older tortoises. We need to explore and analyze any and all factors that may affect predation of tortoises and the success of the future translocation of tortoises from the Western Expansion Area to the Western Expansion Translocation Area prior to moving tortoises.

4. Based on unexplained deaths of two tortoises during 2009 (4548F in September 2009, 4441M in August 2009), we may need to increase the health sampling of tortoises from twice per year to three or four times per year or once per season. Additional sampling may be limited to weighing the tortoises and conducting an abbreviated health evaluation (no drawing of blood or taking a nasal lavage).

5. The ELISA test for *M. testudineum* needs to be validated for *G. agassizii*. (This recommendation is repeated from Berry et al. [2009]). This research project is a very high priority, is essential to resolving questions about translocation, and should be undertaken with appropriate financial support as soon as possible. Until the test is validated, we will have continuing questions about the test and cut-off points for suspect and positive titers. We will be able to make better decisions about translocatees if the validation research has been completed.

6. Quality of Habitat (a recommendation repeated from Berry et al. [2009]). The quality of habitat where translocated tortoises were placed is a topic that needs to be addressed as soon as possible. Were the locations appropriate and if not, why not? As we can see from our data, death rates were highest on plots 3 and 5 and movements of tortoises from their original release points were highest on plot 3 and lower on plots 1.5. The soils, surficial geology, vegetative cover and composition of shrubs, elevation, and potential food sources should be evaluated retrospectively for each release site and for the original home sites as soon as possible to reveal critical factors essential to improving the chances for successful translocations. We plan to initiate such a study in 2010.

Acknowledgements. Dr. Mary Brown and Dr. Lori Wendland of the University of Florida are collaborators on this project. They provided valuable advice on interpretations and will be co-authors on any future publications for the open literature. Dr. Elliott Jacobson, also of the University of Florida at Gainesville, is the pathologist. For tracking, monitoring, and conducting health evaluations of tortoises, we thank Marcella Waggoner, Jeremy Mack, Nate Newman, Kemp Anderson, Rafe McGuire, Sally Boisvert, Tim Hockin, Jessica Kayser, Cynthia Furman, Kevin Walsh, Tonya Rasmussen, Sara Hanner, Al DeMartini, John Boswell, Kevin Lucas, Aaron Keller, Irene Alexakos, Ben Kirkpatrick, Chris Hatton, and John Hillman, Kristina Drake coordinated fieldwork with USGS scientists at the Las Vegas Field Station. Thanks are due to K. Phillips for review and to C. Everly for advice. The National Training Center, Ft. Irwin, provided financial support.

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Table 1. Previous ELISA test results for desert tortoises with positive or suspect tests in 2009. Green cells represent negative status, orange cells represent suspect, and red cells represents positive.

			M. agassizii				***M. testudineum***			
ID	**Sex**	**Plot**	**Sp08**	**Fa08**	**Sp09**	**Fa09**	**Sp08**	**Fa08**	**Sp09**	**Fa09**
4410	M	8								
2040	M	8								
4166	F	1.5								
4423	F	3								
2533	M	1.5				N/A				N/A
4024	M	1.5				N/A				N/A
4257	F	1.5								
4300	M	1.5								
4611	F	8								

Table 2. Summary statistics for movement variables of translocated desert tortoises from March 2008 through December 2009.

	Maximum (m)	Minimum (m)	Mean (m)	SD	N
Dispersal distance	12,567.3	275.2	2,438.3	2,203.6	68
Minimum total distance	18,814.4	1,070.7	5,274.2	3,280.7	68

Table 3. Counts of translocated desert tortoises that are still remaining (On Plot) or that have dispersed (Off Plot) from the boundaries of their initial release plots.

	On Plot		Off Plot		
Plot	M	F	M	F	Total
1.5	5	1	8	10	24
3	1	1	5	3	10
5	0	1	5	1	7
8	4	5	8	10	27

Table 4. Summary of translocated desert tortoises found dead in 2009.

ID	Sex	Plot	MCL	Date Located	Notes
2038	F	1.5	214	22-Sep-09	Likely predation by coyote
4136	F	1.5	201	20-Oct-09	Likely predation by coyote
4162	F	1.5	227	22-Sep-09	Likely predation by coyote
4554	F	1.5	211	4-May-09	Likely predation by canid
2533	M	1.5	260	13-Aug-09	Likely predation by coyote
4024	M	1.5	255	22-Sep-09	Likely predation by coyote
4060	M	1.5	275	22-Oct-09	Likely predation by coyote
2557	F	3	206	4-May-09	Likely predation by coyote
4179	F	3	240	24-Feb-09	Likely predation by coyote
2023	M	3	267	22-Apr-09	Likely predation by coyote
4158	M	3	266	22-Apr-09	Likely predation by coyote
4239	M	3	274	22-Apr-09	Likely predation by coyote
4640	M	3	263	4-May-09	Likely predation by coyote
2550	F	5	211	23-Sep-09	Likely predation by coyote
4288	F	5	229	18-Mar-09	Likely predation by coyote
4548	F	5	227	23-Sep-09	Cause of death unknown; no signs of predation
4556	F	5	280	21-Oct-09	Likely predation by coyote
4644	F	5	232	23-Apr-09	Crushed shell, probable vehicle kill
4073	M	5	262	14-Aug-09	Likely predation by coyote
4108	M	5	266	14-Apr-09	Likely predation by coyote
4129	M	5	284	23-Sep-09	Likely predation by coyote
4291	M	5	262	21-Oct-09	Likely predation by coyote
4442	M	5	273	08-Dec-09	Likely predation by coyote
4085	F	8	223	15-Apr-09	Likely predation by coyote
4106	M	8	265	16-Apr-09	Likely predation by coyote
4361	M	8	211	15-Apr-09	Likely predation by coyote
4441	M	8	246	18-Aug-09	Cause of death unknown; no signs of predation

Fig 1. Overview map of the Ft. Irwin Southern Expansion Area and translocation plots.

Fig 2. Results of ELISA tests for *Mycoplasma agassizii* from desert tortoises sampled in spring of 2009.

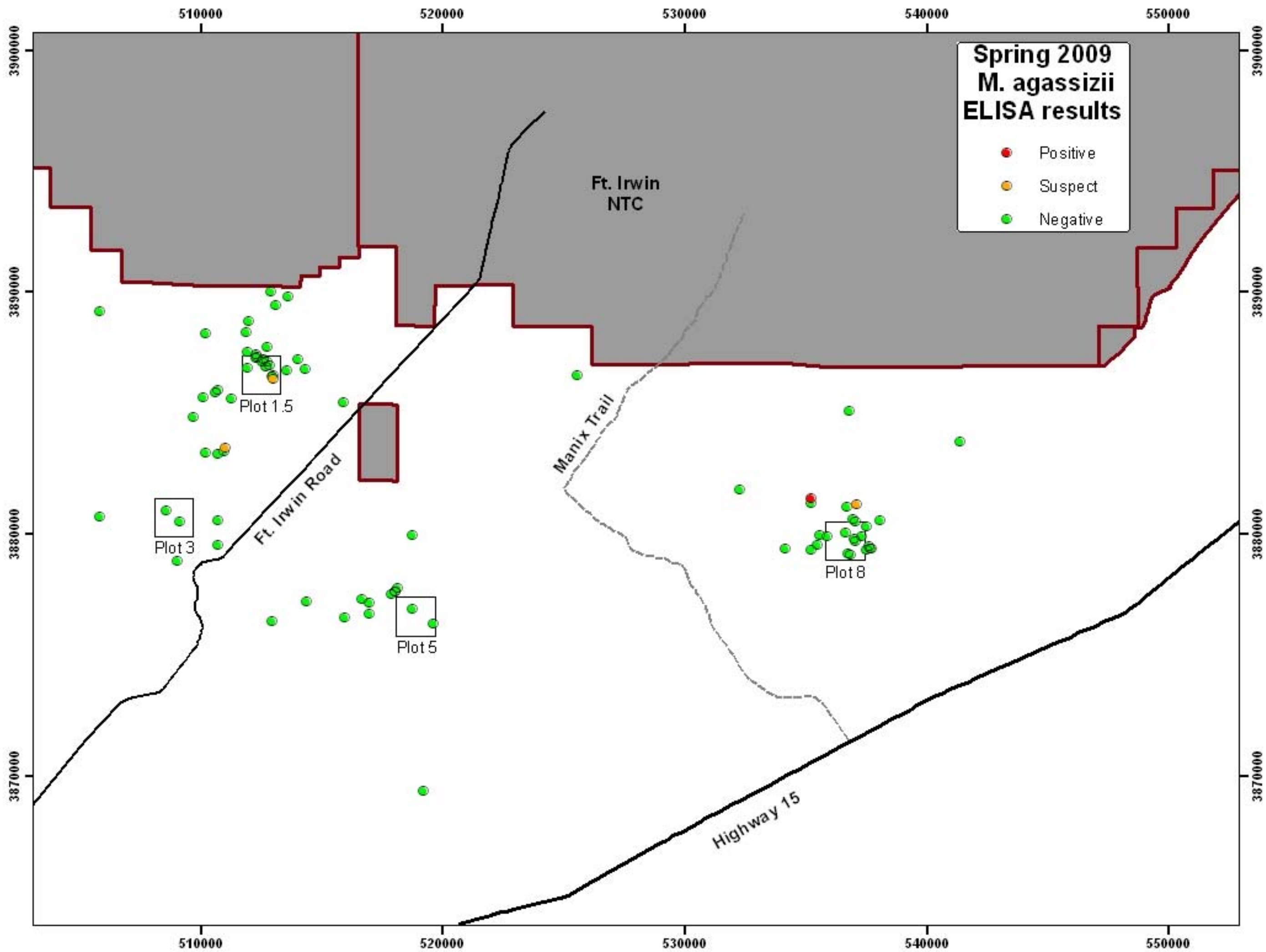

Fig 3. Results of ELISA tests for *Mycoplasma testudineum* from desert tortoises sampled in spring of 2009.

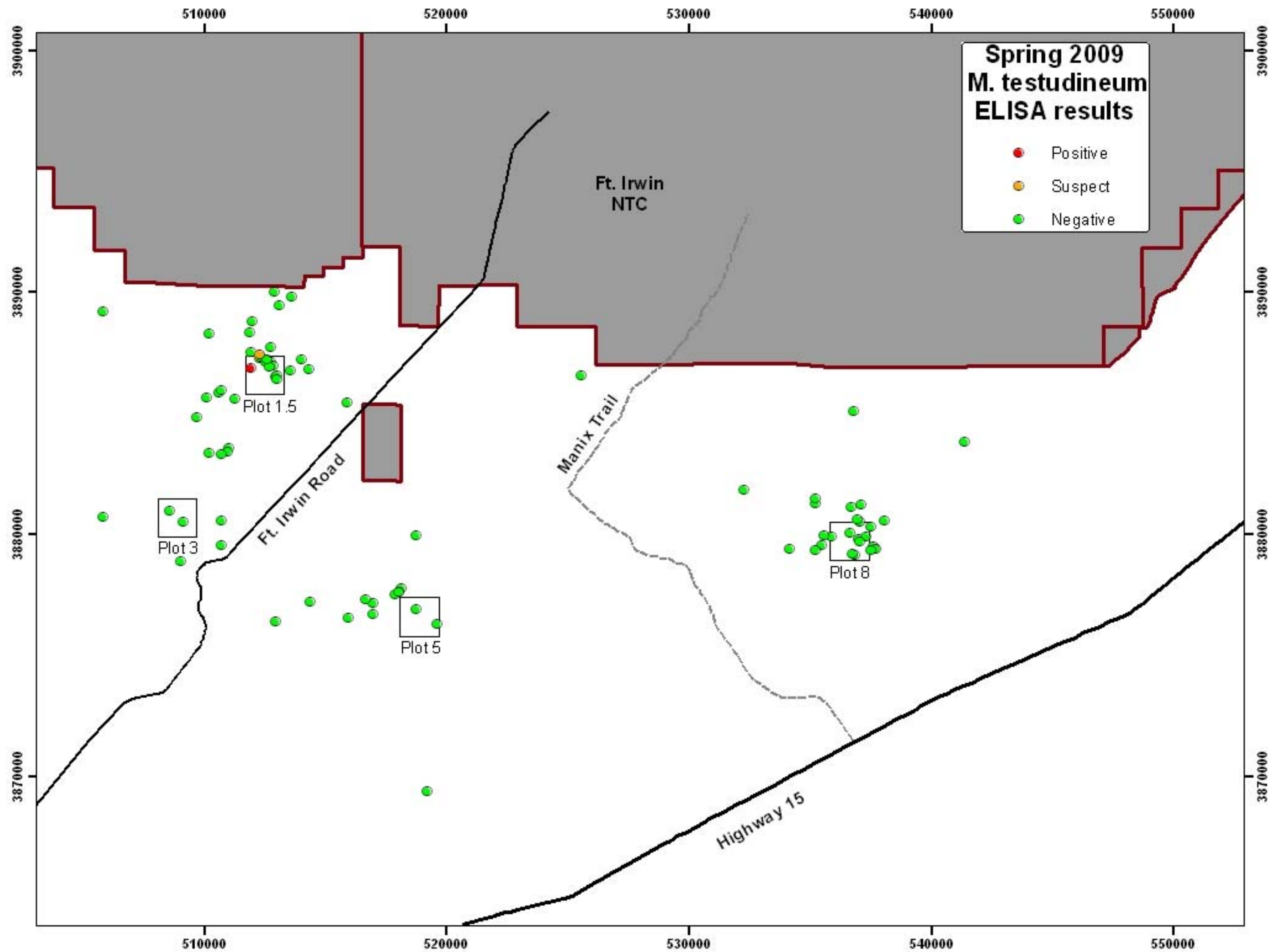

Fig 4. Results of ELISA tests for *Mycoplasma agassizii* from desert tortoises sampled in fall of 2009.

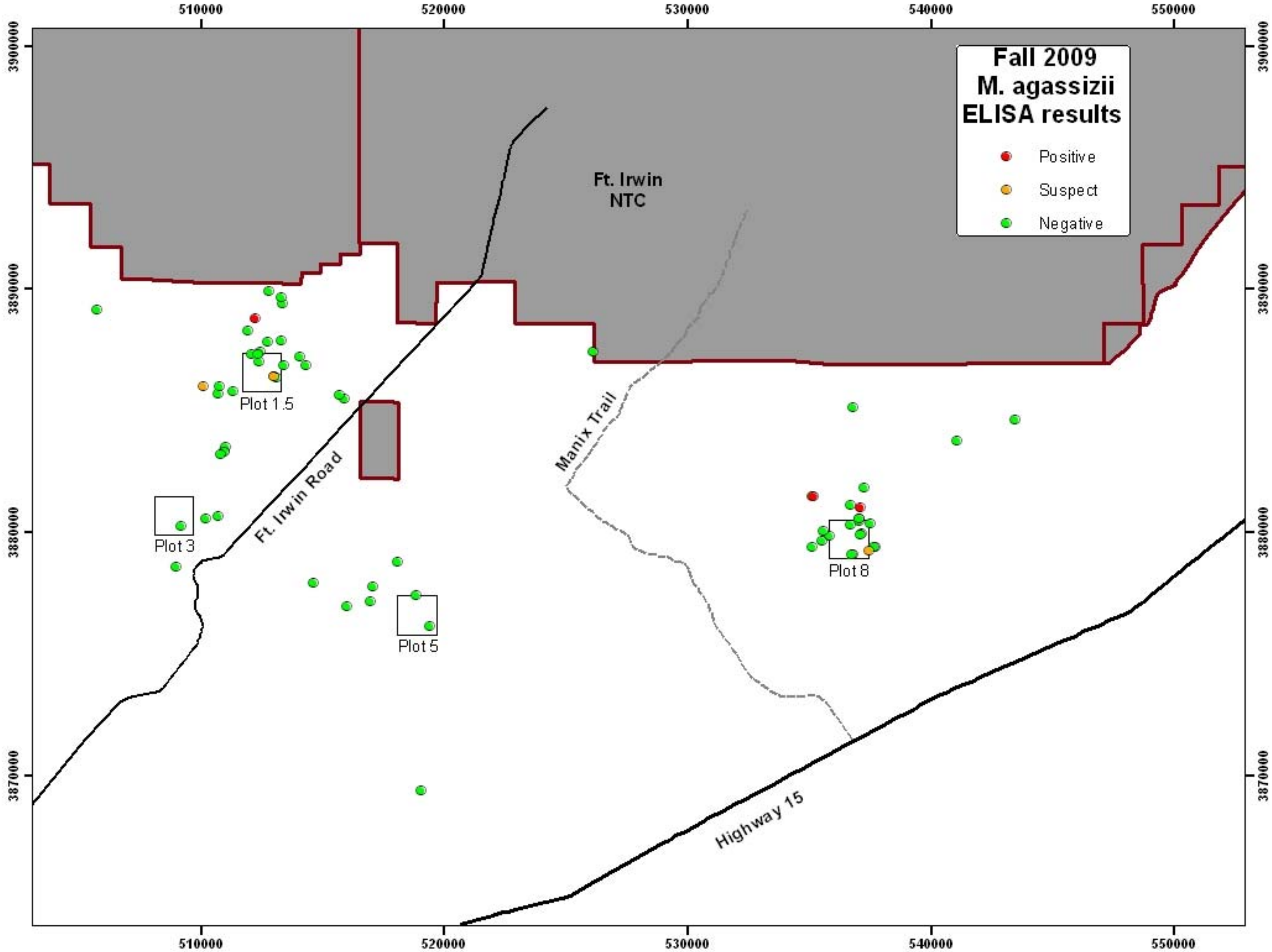

Fig 5. Results of ELISA tests for *Mycoplasma testudineum* from desert tortoises sampled in fall of 2009.

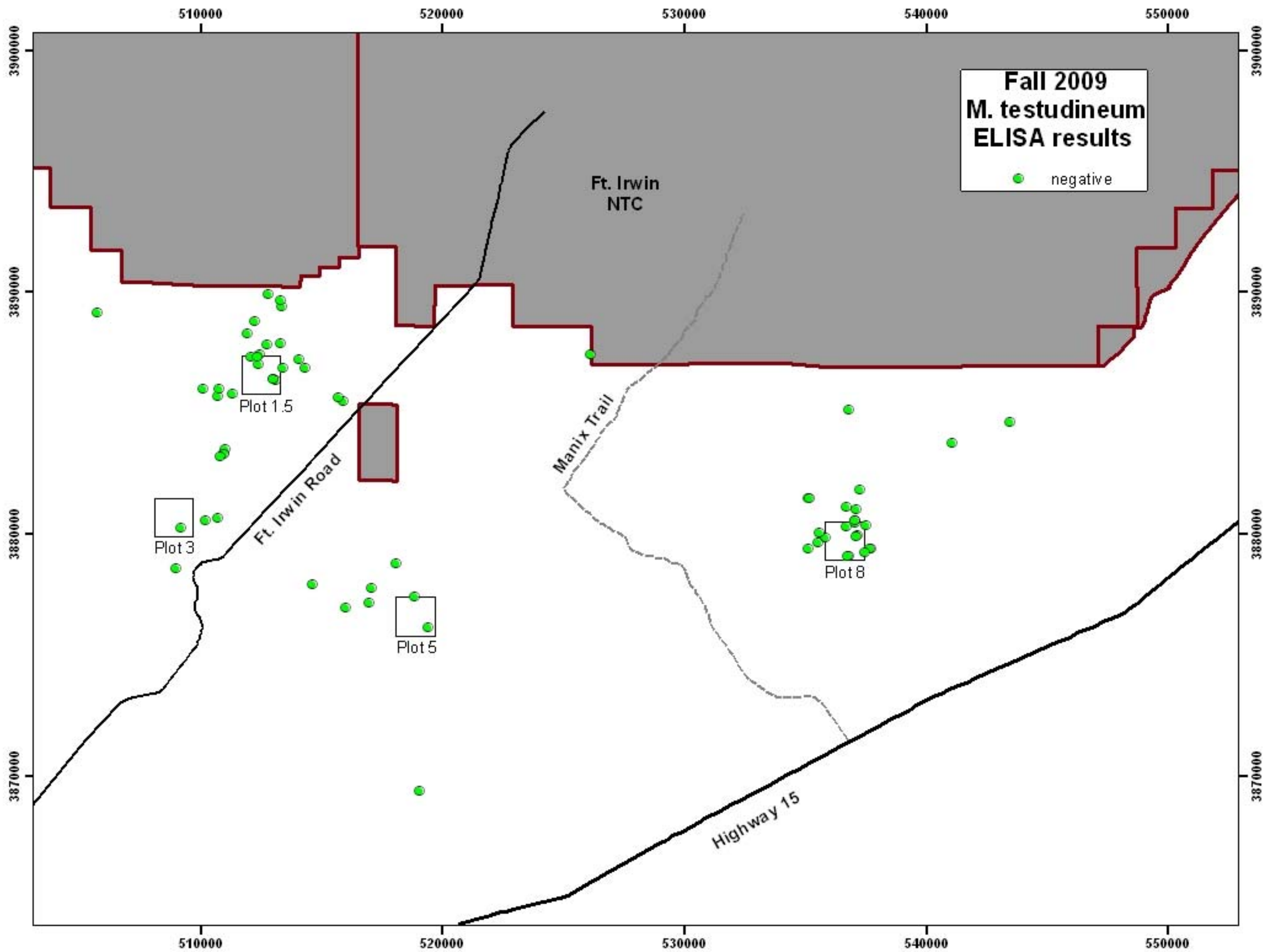

Fig 6. Mean (± SE) weight of desert tortoises (n=64) in four seasons post-translocation.

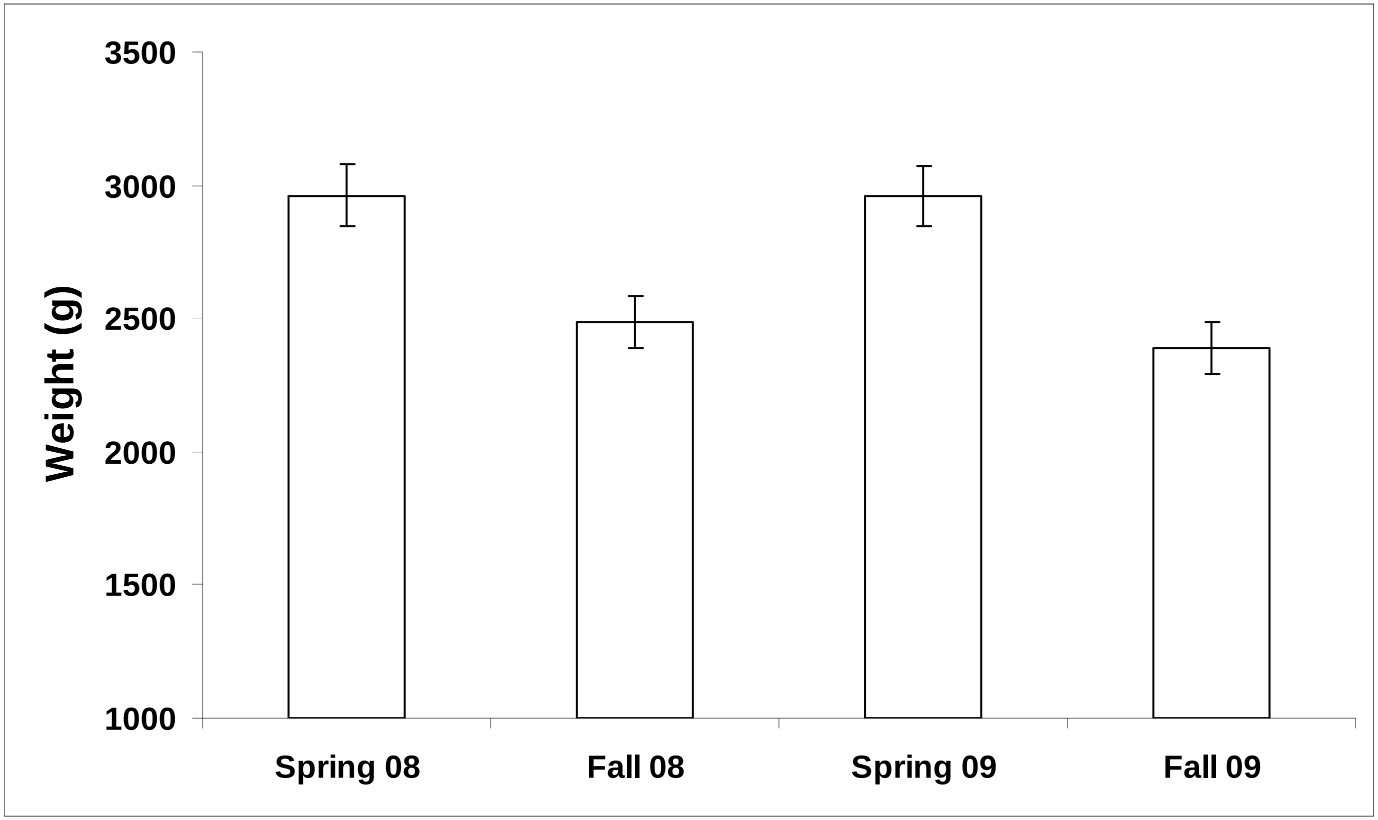

Fig 7. Mean (± SE) distances moved by desert tortoises for each month after translocation.

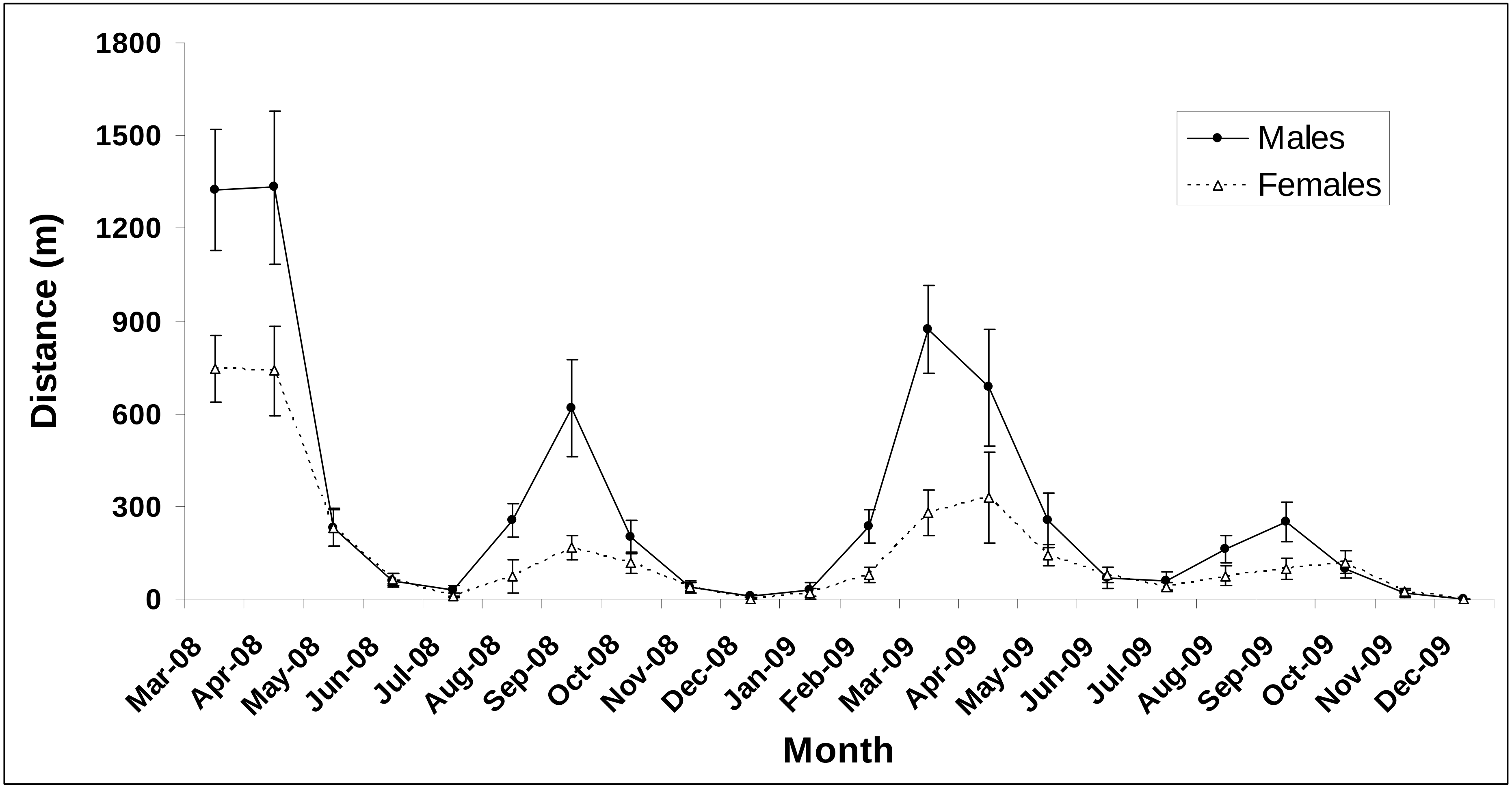

Fig 8. Percent of desert tortoises found dead (# dead/# remaining) by season for the first 20 months after translocation.

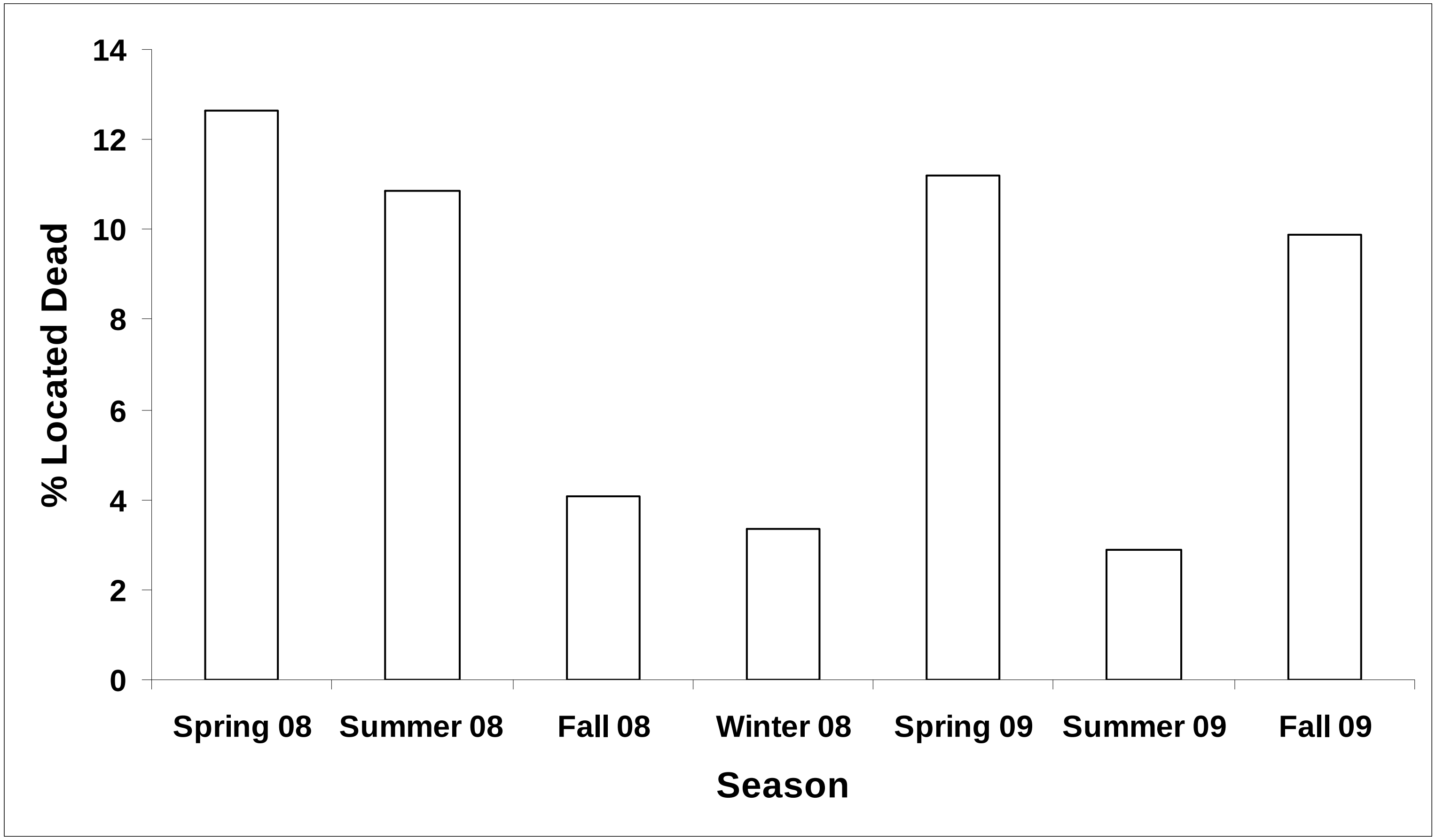

Fig 9. Mean MCL (carapace length at midline, mm) of desert tortoises located dead for each month after translocation. Note the increase in size of males found dead over time and the decrease in size of females.

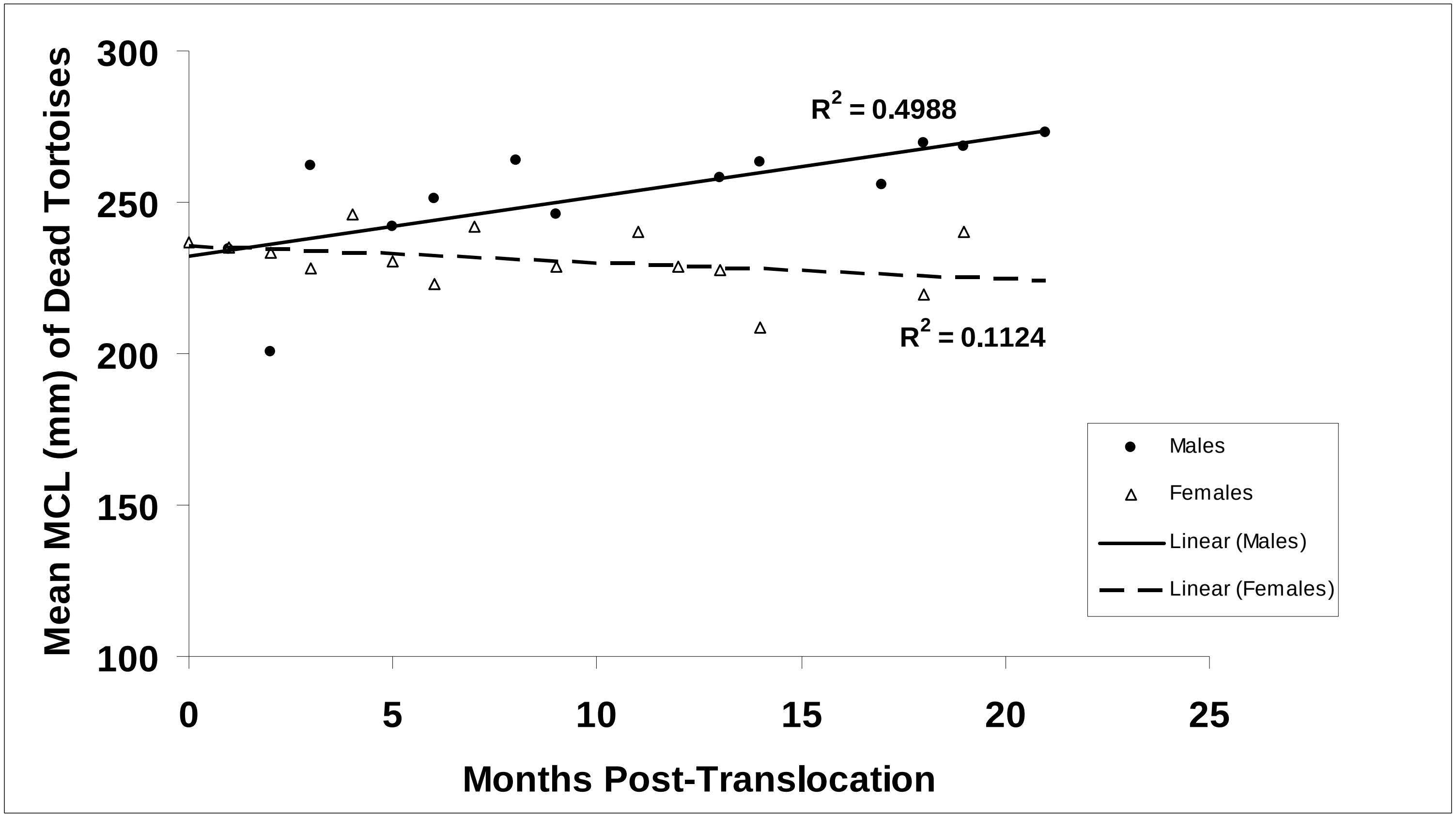

EXHIBIT 614

PROGRESS REPORT FOR 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

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An Evaluation of Desert Tortoises (*Gopherus agassizii*) and Their Habitats at 47 Sample Plots in the Western Expansion Area, Fort Irwin Translocation Project, San Bernardino County, California

Abstract. The Ft. Irwin Translocation Project (FITP) for desert tortoises (*Gopherus agassizii*) is in the fifth year of a multi-year effort. During 2009, 48 plots were selected for surveys in the Western Expansion Translocation Area (WETA). The data are to be used to prepare a model which would identify potential release areas for tortoises to be translocated from the western expansion of Ft. Irwin. Of the 48 plots, three plots previously received preliminary or comprehensive surveys during fall of 2008. Surveys were not repeated on these plots in 2009 and the data are not included here.

Two types of surveys were conducted: (1) preliminary surveys of each plot to count signs of tortoises and common predators of tortoises and to evaluate habitat and anthropogenic impacts; and (2) comprehensive surveys to locate and evaluate each adult tortoise for health and disease on each plot. For the preliminary surveys, fieldworkers walked transects on 45 plots to collect data on tortoise and predator sign and to characterize vegetation, topography, surficial geology and anthropogenic impacts. Transects were 10 m wide by 5.3 km to 11.0 km in length, and each plot was 2.59 km^2. Counts of tortoise sign ranged from 0.0 to 4.1/km of transect with 12 plots having moderate to high counts ($\geq$1.0 sign/km). Sign counts of tortoise predators ranged from 0.23/km to 7.97/km with higher counts on 8 plots (plots 1, 4, 5, 7, 8, 27, 34, and 35) than elsewhere.

Plots ranged in elevation from 604 to 1205 m. Dominant vegetation on 40 plots was creosote bush (*Larrea tridentata*) and burro bush (*Ambrosia dumosa*); salt bushes (*Atriplex* spp.) and other members in the Chenopodiaceae formed the dominant vegetation on five plots. Perennial vegetation in some disturbed areas was characterized by almost monotypic stands of salt bushes. The composition of shrubs in areas historically and recently grazed by livestock favored unpalatable species, such as Cooper's goldenbush (*Ericameria cooperi*), cheese bush (*Hymenoclea salsola*), and matchweed (*Gutierrezia* spp). The plots had a wide range of topographic features and surficial geology, from playas on valley floors to alluvial fans, rolling hills, rocky outcrops, badlands, and cliffs. Thirty-three plots had >80% of surface area and soils suitable for walking and digging. Parts of two plots were playas or old lakebeds and one plot had substantial volcanic fields. Parts of seven plots had one or more features of terrain and soils that were unsuitable for walking or digging (steep, rocky, or boulder-strewn slopes, cliffs, badlands).

Anthropogenic impacts were numerous and included trash and balloons; dirt roads; motorcycle trails and tracks left by cross-country travel of off-road vehicle users; areas denuded of vegetation; old structures and a shrine to off-road vehicle users; casings and targets from firearms; livestock scat and watering areas; and hazards in the form of mining shafts and pits, unexploded ordnance, and signs of domestic dogs. Several plots had hazards that present risks to tortoises. Plots with high counts of anthropogenic impacts were 7, 6, 2, 47, and 41.

Forty-seven plots received comprehensive surveys for live tortoises using 15-m wide transects. From 0 to 21 tortoises and from 0 to 87 shell-skeletal remains were found on each plot, for a grand total of 267 live tortoises and 1457 dead tortoises on the 47 plots. Of the 267 tortoises, 240 were available and of sufficient size for health evaluations. The sex ratio of adult tortoises was predominantly male. The 240 tortoises were evaluated for health and blood samples were drawn; 21 (8.75%) tortoises had positive or suspect ELISA tests for *Mycoplasma agassizii;* one tortoise with a positive ELISA test for *M. agassizii* also had a positive ELISA test for *M. testudineum.*

INTRODUCTION

The Ft. Irwin Translocation Project (FITP) for desert tortoises (*Gopherus agassizii*) is in its fifth year of a multi-year effort. Tortoises were translocated from the National Training Center's Southern Expansion Area (SEA) into parts of the Superior-Cronese Desert Wildlife Management Area and critical habitat in spring of 2008 (e.g., Berry et al. 2009, Gowan and Berry 2010). Planning has been underway for several years to undertake a similar translocation of tortoises from Ft. Irwin's Western Expansion Area (WEA) into the Western Expansion Translocation Area (WETA). The plan for the translocation of the SEA tortoises (Esque et al. 2005) was amended for translocation of the WEA tortoises (Esque et al. 2009). In early 2009, Esque and others selected 48 plots for evaluation. Three of the 48 plots had received preliminary surveys and one had been comprehensively surveyed in the fall of 2008 (Berry 2009).

The U.S. Geological Survey's health team (led by PI Kristin Berry of the Box Springs Field Station) had the task of evaluating the 48 plots and the health of tortoises on the plots. During spring and fall of 2009, the health team focused on two objectives: (1) to evaluate the relative densities of tortoises and their sign, vegetation type, topography, surficial geology, and anthropogenic impacts; and (2) to determine the health and disease status of resident tortoises on the plots. The ultimate objective was to determine the suitability of the sites, or sites like these, for release of the translocated WEA tortoises.

MATERIALS AND METHODS

Collection of Data

Todd Esque, Ken Nussear, Phil Medica, and Karla Drake (U.S. Geological Survey's office in Henderson, Nevada) provided the locations of the 48 1–mi^2 (2.59 km^2) plots to sample (Figure 1, Appendix 1). We conducted two types of surveys: (1) preliminary surveys of each of the 48 plots to count signs of tortoises and common predators of tortoises and to evaluate habitat and anthropogenic impacts; and (2) a comprehensive search of the plots most likely to have tortoises for assessing health status. Three of the plots had received partial or complete surveys in fall of 2008, thus reducing the survey effort in 2009 to 45 plots to receive preliminary surveys and 47 plots to receive comprehensive surveys.

Preliminary Surveys of the 45 Plots

These surveys were conducted between May 5 and June 9 in spring and September 29 and November 15 in fall by three experienced field workers (primarily K. Anderson, also P. Kermoian, T. Hockin, and J. Hillman). They walked 10-m wide transects along the plot boundaries (west, north, east, south), except in cases where the habitat was unlikely to support tortoises (e.g., volcanic fields, steep and rough terrain). Where habitat appeared to be appropriate for supporting tortoises and was heterogeneous, and additional information was desired, fieldworkers walked additional, diagonal transects, i.e., from the northwest to southeast and southwest to northeast corners.

Data recorded for the preliminary surveys on tortoises included numbers of live tortoises (with estimated size/age), shells or shell-skeletal remains, active and inactive cover sites, scats, and other, miscellaneous sign (tracks, courtship rings, drinking depressions, etc.). Middens of wood rats were superficially examined for tortoise remains. Scats of tortoise predators, in particular coyotes (*Canis latrans*) and kit foxes (*Vulpes macrotis*) were checked for remains of tortoises. Locations of each live tortoise and remains of dead tortoises were noted but not extracted. Tortoise cover sites or shelters (burrows, caves, pallets, and rock shelters) were counted and each assigned a status based on activity. An active cover site was defined as currently having a tortoise, showing signs of recent use, or a tortoise could walk or plow into it and use it immediately. An active cover site also contained minimal plant debris or drifted sand. Inactive cover sites required some excavation by the tortoises, had signs of structural degradation at the corners of the burrow opening and at the mouth, or were collapsed or partially collapsed, requiring a major excavation effort for use.

Signs and presence of predators (individual predators or calls; numbers of scats, roost sites, dens, and digs) were recorded for coyotes, kit foxes, common ravens (*Corvus corax*), and domestic dogs (*Canis familiaris*). Scats were noted as occurring individually or as a group of scats or marking area.

Qualitative data were collected for perennial shrubs and non-native annual plants. Fieldworkers recorded species present and placed each species in one of five categories: 1) dominant or ubiquitous, 2) common, 3) sparse, 4) rare, or 5) one or two individuals on transects. Plant nomenclature followed Baldwin et al. (2002). The types of topography, soil surface, and surficial geology were noted by the estimated percentage within the plot. The types of topography included alluvial fan, badlands, lake beds, large and small washes, rolling hills (low), sand dunes, very large boulders, very steep slopes or cliffs, volcanic field, or other. The categories of surfaces of the substratum were designed to estimate the ease of walking for tortoises: 1) alluvial fan, valley floor, no obstacles; 2) alluvial fan, valley floor with minor obstacles; 3) desert pavement (tortoises can walk on it); 4) rocky surface (very difficult for walking); 5) steep, rocky surfaces (very difficult walking); and 6) other. The definitions for surficial geology were designed to measure ease of constructing and maintaining burrows or other cover sites: 1) sandy loam, easy digging and will support a burrow; 2) wash banks with easy digging and supporting a burrow or cave; 3) existing caliche caves in washes, easy digging under granitic boulders; 4) surficial geology not amenable for supporting burrows or only a rare burrow; and 5) other.

Anthropogenic impacts were quantified and included: cattle or sheep sign (scat, trails and wallows); trash (separated into general, balloons, and firearm casings/targets); people (present or as footprints); people (evidence of vandalism); paved roads, dirt roads, vehicle tracks (categorized as recent, old, or denuded area); road berms or other berms to redirect water; evidence of fire/campsites; fences; mining (pits, excavations); power/utility lines; signs of domestic dogs; structures; and other.

Comprehensive Searches of 47 Plots for Tortoises.

Teams of several people searched for live tortoises and remains on each plot between May 5 and June 10 in spring and September 15 and October 31 in fall by walking 15-m wide transects. When a tortoise was located, it was processed using standard procedures described in earlier reports (e.g., Berry and Mack 2008). Briefly, the health/disease research team evaluated the tortoises for health status using a seven page health evaluation form, a modification of the appendix in Berry and Christopher (2001). Samples of blood were drawn from most tortoises, either by subcarapacial or brachial venipuncture using standard protocols (Hernandez-Divers et al. 2002, Berry et al. 2006a). Samples of blood that contained ≥10% lymph were considered to be suboptimal because of the potential for dilution (e.g., Gottdenker and Jacobson 1995, Berry et al. 2005). A nasal lavage was taken only on tortoises with clinical signs of upper respiratory tract disease. Plasma and nasal samples were shipped to the Mycoplasma Laboratory at the University of Florida to determine the presence of antibodies to *Mycoplasma agassizii* or *M. testudineum* using enzyme-linked immunoassay (ELISA) tests (Schumacher et al. 1993; Brown et al. 1994, 1995, 2001, 2004; Wendland et al. 2007). The nasal lavage samples were cultured and if *Mycoplasma* spp. grew in culture, then the taxon was identified (Brown et al. 2002).

RESULTS

Preliminary Surveys of the 45 Plots

The distances that fieldworkers walked on transects for each plot ranged from 5.3 to 11.0 km; most plots received ≥6.4 km of transects. For all 45 plots, 11 live tortoises, remains of 59 dead tortoises, 29 active and 152 inactive cover sites, and 152 scats were observed on 432 km of transects (Table 1). Counts of tortoise sign per kilometer of transect varied from 0.0/km to 4.09/km with plots 1, 2, 3, 4, 12, 20, and 21 having high counts (2.18–4.09/km), followed by plots 5, 9, 10, 18, and 26 with counts of 1.00–1.91/km. Twenty-two plots had counts of 0.2–0.9 sign/km, and 11 plots had very low sign counts (0–0.18/km).

Observations of predators or predator sign included coyote, kit fox, ravens, bobcats, and domestic dogs. Sign counts of predators per kilometer of transect ranged from a low of 0.23/km on plot 32 to a high of 7.97/km on plot 7 (Table 2). Plots with high sign counts per transect (2.0–7.97/km), in descending order, included: 7, 8, 35, 4, 1, 27, 34, and 5. Lower counts of sign (<1.0/km) were on plots 6, 10, 14, 22, 28, 30, 32, 36, 37, 38, 41, and 63. The plots with sign or sounds of domestic dogs were 2, 4, 5, 6, 7, 22, and 27.

The perennial vegetation, represented by 23 species of shrubs, Joshua trees, and four species of perennial grass, varied from plot to plot (Table 3). Overall, creosote bush (*Larrea tridentata*) and burro bush (*Ambrosia dumosa*) were among the top five dominant (common to abundant) species on 40 plots. Salt bushes (*Atriplex* spp.), family Chenopodiaceae (e.g., allscale, *A. polycarpa*; shadscale, *A. confertifolia*; four-wing salt bush, *A. canescens*) formed the dominant vegetation on 5 plots (6, 7, 36, 40, 47). Some species of salt bushes thrive in disturbed areas (allscale, four-wing salt bush), adjacent to playas, and in alkaline soils—all areas of potentially poor habitat for tortoises. Playas, areas with the appearance of old lake beds, and vegetation typical of alkaline soils were present on plots 36 and 47. Cooper's golden bush (*Ericameria cooperi*), a colonizer or "increaser" species, is typical in areas grazed by livestock because it is unpalatable. It can be a sign of fair to poor range condition, especially when it is common. Eleven plots had Cooper's golden bush among the top five perennial species (plots 8, 19, 37, 38, 39, 41, 44, 45, 61, 62, 64).

Using the transects and observations of the landscape, the topography and surficial geology were evaluated to assess suitability for tortoises to travel, construct burrows, and have suitable cover to survive temperature extremes during or after translocation. Much of the area was composed of valley floor, alluvial fans and low, rolling hills cut with small washes or washlets—topographic features that are typical of tortoise habitat. Elevations ranged from 604-1205 m; 20 (43%) of the plots were below 950 m (plots 1–7, 10–14, 20–23, 27, 29, 36, 40, and 47). However some sites contained unsuitable habitat or areas that would support few or no tortoises: playas or barren areas that appeared to be either old lakebeds or heavily disturbed sites denuded of vegetation (parts of plots 36, 40, and 47), volcanic fields, badlands, steep slopes with cliffs, and boulder fields (parts of plots 3, 6, 9, 16, 19, 20, 21, 22, 24, 25, 27, 28, 29, 32, 38, 39, 45, 62) (Table 4). The plots were ranked on whether the topography was suitable, as well as the percentage of the plot where the tortoise could walk and dig a burrow. Most plots showed high potential for supporting tortoises based solely on topography and surficial geology (90–100% of habitat usable): 1, 2, 4, 5, 6, 7, 8, 10, 12, 13, 14, 16, 17, 18, 20, 21, 22, 23, 30, 33, 46, 37, 40, 41, 44, 61, 63, and 64. The next or mid-level group of plots had 50-89% usable and suitable habitat: 3, 19, 24, 25, 26, 27, 29, 32, 34, 26, 38, 39, 45, 47, and 62. The plots with 10 to 40% suitable habitat were 9 and 28.

Anthropogenic impacts for the plots are summarized in Table 5. The transects represent a surface area of 0.053–0.11 km^2, or 2–4% of each plot. The most common types were balloons (all plots), trash (44 of 45 plots), old vehicle tracks (43 of 45 plots), and firearm casings/targets (43 of 45 plots). Plots 47, 23, 21, and 14, in descending order, had the highest numbers of balloons; plots 2, 47, 7, 5, 10, and 6 had higher levels of trash than elsewhere. Firearm casings and shooting targets were present on all but plots 2 and

21, with higher levels on plots 5, 26, 14, 62, 47, and 44 (descending order of counts) than on other plots. Ordnance was observed on plots 1, 4, 12, 14, and 23; possible unexploded ordnance was present on plot 63 (Table 5, notes). At the edge of plot 10 were 21 tires; on plot 38, 16 vehicle tires in 3 groups of 10, 3, and 3 had been bolted together and dragged to the southeast corner of the plot.

Recent vehicle tracks were present on transects for 35 of 45 plots and old vehicle tracks were evident on 43 of 45 plots (Table 5). Plots with higher levels of recent tracks included 29, 6, 13, 41, 5 and 28 (descending order); plots with higher levels of old tracks were 41, 6, 29, 9, 21, 17, 20, 16, and 30 (descending order). Active motorcycle trails were noted on 19/45 plots, with more trails on plots 41 and 19 than others. Dirt roads at densities of 0.11–2.53 km of transect/plot were present on 37/45 plots. Some plots had major dirt roads that were a part of or led to points of interest: plot 64, the Twenty Mule Team Road; plot 63, road to Blackwater Well; plot 29, Black Canyon Road and Black Mountain Wilderness; plots 17, 25, and 31 Copper City Road; plot 26, Opal Mountain Road and road to springs; plot 5, Hinkley Road; plots 1 and 2, road to Fossil Canyon; plot 3, adjacent to Rainbow Basin; plot 12, crossed by Coolgardie Road; plot 18, routes leading to Williams, Lane, and Noble wells; and plot 33, BLM route C312. In addition, many plots had dirt roads along one or more boundaries to the north, east, south, and/or west.

Cross-country motorcycle trails and tracks were observed on transects for plots 6, 9, 16, 17, 19 (cross-country motorcycle trail following an unauthorized route marked by orange flagging), 22, 24, 25, 27, and 29 (Table 5). Areas severely damaged and/or denuded, probably by vehicles, occurred on plots 6, 10, 16, and 30. Nine plots had camping and/or shooting areas. Plot 30 had an apparent stolen car with belongings (CA license 1LJA319). Plot 41 had a shrine consisting of an upright motorcycle with other off-road vehicle (ORV) parts scattered about, e.g. ~40 plaques commemorating deceased ORV racers, and an American flag. Sixteen people in four groups visited the shrine while the fieldworker was walking transects. Discarded signs (vandalism) for vehicle routes, closed areas, and Wilderness were found on plots 7, 29, 30, 36, and 41.

Livestock scat and/or bones were present on transects for 25 of 45 plots (Table 5). Livestock sign was highest on plot 7, followed by plots 6, 61, 5, and 4 (descending order). Plot 6 had heavy pressure with almost no shrubs present; an old cattle watering site is on plot. Old cattle trails are evident on plot 7. Plots 6 and 7 are bordered by active agricultural fields; plot 6 has a ranch. Signs of a burn were on plot 44. Signs of domestic or feral dogs (scats, barking) were observed on plots 6, 7, 14, and 27; kennels with > 100 dogs were on plot 7. Plot 29 has an upland game guzzler, which is a known source of death to tortoises (depending on whether it has been retrofitted or appropriately fenced).

Mining activities were evident on transects for 15 of the 45 plots (Table 5**.** Hazards in the form of mining shafts, pits, and well casings—sources of deaths for tortoises—were present on plots 7, 16, 19, 24, and 30. Current and historic placer mining (craters, pits, trenches) has or is occurring on plots 9, 10, 16, 17, 18, 24, and 25.

Abandoned shacks, probably associated with mining and/or livestock use or both, were present or nearby on plots 9, 16, 18, and 19.

When the total counts of impacts per kilometer of transect are summed and a grand total is computed for each plot, plot 7 has the highest level of impacts (143.60), followed, in descending order by plots 6, 2, 47, and 41 (Table 5). The impacts are not weighted by potential severity or risk of mortality for the tortoises with this method, however.

The land where the plots occur is currently managed primarily by the Bureau of Land Management (BLM). Plots 61, 62 and 64 are on the boundary with the Naval Air Weapons Station (NAWS). The southwest corner of plot 62 borders the northeast corner of the Cuddeback Impact Area, an area with substantial surface disturbance in limited areas and formerly under the jurisdiction of the Air Force.

The region in which the 47 plots occur has several points of interest for recreationists who visit BLM-administered lands (U.S. BLM, 1980 as amended): the Grass Valley Wilderness and Black Mountain Wilderness; the Barstow Woolly Sunflower Area of Critical Environmental Concern (ACEC), Harper Dry Lake ACEC, Rainbow Basin National Natural Landmark ACEC, Inscription Canyon Petroglyph Site, Superior Dry Lake (used for land sailing), Cuddeback Dry Lake (numerous recreation uses), and Owl Canyon Campground.

Evaluation of Tortoise Sign from Comprehensive Surveys of 47 Plots

Forty-seven of the 48 plots in the study design received comprehensive surveys in 2009; the exception was plot 31, which was previously surveyed in fall of 2008. The objectives were to locate 15 to 20 live adult tortoises, conduct health evaluations and collect blood and potentially nasal lavage samples for ELISA tests and cultures for *Mycoplasma agassizii* and *M. testudineum*. Data were also collected on numbers of live tortoises, shell-skeletal remains, burrows, scats and other sign (Table 6). From 0 to 21 live tortoises and from 0 to 87 shell-skeletal remains of tortoises were found on each plot, for a total of 267 live tortoises and 1457 dead tortoises. When the counts of live tortoises were converted to live tortoises observed per kilometer walked, plot 12 had the highest number, followed by plots 3, 20, 4, 36, and 24. No live tortoises were found on plots 6, 7, 17, 28, 29, 30, 35, 41, 61 and 64. Likewise, when all the live and dead tortoises, burrows, scats and other types of sign are summed and converted to sign per kilometer walked, plot 12 had the highest counts, followed by plots 20, 2, 3, 1, and 4. Plots 6, 7, 30, 41, and 61 had substantially lower counts, and the sign was of shell-skeletal remains, inactive burrows, and scat. Many plots had high ratios of dead to living tortoises (plots 8, 13, 14, 22, 23) or many remains and no live tortoises (plots 17, 28, 29, 30, 35).

Tortoises (N=267) were observed in and out of burrows during the comprehensive surveys of plots. Of these, only 9 (3.4%) were juveniles or immature sizes (Table 7). Of the 267 tortoises, 240 received health evaluations. The sex ratio of subadult and adult tortoises was 141 males to 99 females and was significantly different from the expected 1:1 ratio ($Z = 2.769$, $p < 0.05$); no adult tortoises were found on five plots. Three plots (8, 13, 14) had live tortoises, but none of the tortoises received health evaluations because tortoises could not be retrieved from burrows or were too small for sampling.

The Health Status of Tortoises on 47 Plots

Two hundred forty tortoises were evaluated for health. Of the 240 tortoises, a total of 21 tortoises (21/240 = 8.75%) had positive or suspect ELISA tests (Figures 2 and 3). Fourteen of the 21 tortoises with suspect or positive ELISA tests were males. Thirteen tortoises had positive ELISA tests and 8 had suspect ELISA tests for *M. agassizii*. One tortoise had positive ELISA tests for both *M. agassizii* and *M. testudineum* (tortoise 7324). These tortoises had mild to severe clinical signs of upper respiratory tract disease (URTD) (Table 8). Ten tortoises with negative ELISA tests for *Mycoplasma* spp. also exhibited moderate to severe clinical signs of URTD (Table 9).

We conducted a preliminary analysis of trauma to the shell and limbs of the 240 tortoises and identified 42 individuals that showed signs of having been attacked by a canid predator, particularly a domestic dog. These tortoises had moderate to severe damage to the gular horn and other parts of the shell and limbs (Table 10). Tortoises with signs of this type of attack occurred on 21 plots (Figure 4).

DISCUSSION

NOTE: some material is repeated from Berry (2009)

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Suitability of Habitat at the 47 Sites for the Translocatees

The following discussion is based on the assumption that the 47 sites are typical of habitat in the general area where translocatees from the WEA are likely to be released. It is similar to the information presented in Berry (2009) for the 2008 Progress Report on the same topic.

Many factors should be considered in determining whether an area or region is suitable to receive several hundred translocated tortoises. Questions to be addressed include, but are not limited to:

- Is the habitat where the translocatees will be placed similar to the original home sites of the translocatees? How similar? Elevation, rainfall patterns, cover values and composition of perennial plants, and surficial geology are important factors.
- Do the release sites present hazards to the tortoises?
- Will the release sites support the translocatees? Will forage be adequate and of the appropriate composition of species? What is known about the annual plants at home sites vs. potential release sites?

- Will the translocated tortoises be likely to remain at the new home sites or will they leave? If the translocatees are likely to travel until they find habitat similar to the original home sites, where is the nearest such habitat?
- If translocatees move away from the release sites, what hazards might they encounter and would these hazards reduce their potential for survival? What is the proximity of the hazards?

We do not have answers to all of the questions above, nor are data currently available to address all of the questions. We do have some relevant information on the original home sites and the potential release area from visits to the home sites and from transects walked on the 47 plots. The elevations where the potential translocatees now live are generally higher (>900 to 1300 m) than on the 47 sampled plots (604 to 1205 m). Twenty (43%) of the plots were <950 m in elevation. The composition of perennial plants where most of the potential translocatees now live is, in general, typical of higher elevations, e.g., areas with Joshua tree woodlands, mixed desert scrub, and a creosote bush-mixed scrub. In contrast, a substantial part of the perennial vegetation in the areas proposed for release of translocatees is typical of lower, more alkaline areas with playas and old dry lakebeds, badlands, and volcanic fields. While there are areas with Joshua trees and mixed desert scrub, such sites are more limited and patchy in distribution. Most of the tortoises likely to be translocated may have had little experience with the almost monotypic allscale and other alkali sink communities that border playas, old dry lake beds, disturbed areas, and edges of some volcanic fields—habitats that are common in the proposed release areas and that may present hazards of exposure due to low cover of shrubs and limitations on constructing burrows. The above statements are generalities based on field observations.

The lands proposed for release of the translocatees probably have had a more layered and complex history of disturbance than the lands where the potential translocatees now live. The history of human uses is relevant because anthropogenic uses affect condition of habitat, biomass of forage available for tortoises, cover of shrubs, and potential hazards to survival. For convenience, we can divide the Central Mojave Desert into lands considered as potential release areas (west and south, where plots 1–64 occur in the WETA) and home sites of the WEA translocatees (east).

The lands have been used by people for a long time. Native Americans used the region and water sources. One such water source, now known as Blackwater Well (close to plots 61–64), was used at least periodically from ~1200 B.C. to 1820 A.D. (Whitley 1999, National Register of Historic Places 2000). The west Central Mojave Desert was crossed both north-south and east-west from the 1850s by explorers, government employees from the General Land Office, settlers, and travelers headed to points of interest and mining towns (see Bureau of Land Management, 1854, 1855, 1856; Surveyor General of California 1857; Bancroft and Co. 1868; Birnie 1876; Wheeler 1879; Palmer 1891; Merriam 1893). Roads were already described in journals in 1855-1856 (Bureau of Land Management [McDonald], 1855-56). A principal north-south route extended from the vicinity of Barstow north to Pilot Knob, and from Pilot Knob north to Panamint City, Darwin, and many mining towns. The route to Pilot Knob also had travelers heading west to Blackwater Well, to springs in the El Paso Mountains and to points further west (e.g., Kernville, Central Valley), as well as east to Death Valley and parts of the eastern Mojave Desert. The Twenty Mule Team Road is an example of an east-west/southwest route from Death Valley to the rail head at Mojave (Weight 1955); it passed through the Pilot Knob area and Granite Wells. Travelers removed shrubs for fire wood, a "desert load of hay," for personal use and for the mills, stripping areas of vegetation (Spears 1892, Hufford 1902, Mendenhall 1909). These routes were also stock driveways.

Livestock, primarily sheep and cattle, grazed throughout the area from at least the 1870s (Birnie, 1876, Palmer 1891, Spears 1892, Starry 1974) until the 1990s. Feral burros are still common on the NAWS in the south range, adjacent to the study area. The west half of the area has several former grazing allotments, as well as numerous springs, wells, and troughs (Mendenhall 1909, Thompson 1921). The distribution and density of the water sources is an important consideration in terms of hazards to tortoises and current habitat condition. Each of the water sources is likely to have an associated piosphere of disturbance (Brooks et al. 2006), limited cover of perennial shrubs, and increased cover of alien annual plants. Piospheres and associated waters may also serve as attractants to predators. The travel corridors and history of livestock grazing are important in terms of evaluating the potential of release areas to support high quality forage for the tortoises (e.g., Brooks and Berry 2006). Some parts of the proposed release area, e.g., former travel corridors or grazing allotments, may no longer have the supply and composition of annuals essential for maintaining healthy tortoises (Oftedal 2002). The east Central Mojave Desert, where the potential translocatees now live, may have more suitable forage. These topics are appropriate for hypothesis testing.

Human traffic and recreation pressures in the WETA are likely to be more substantial than observed in the lands associated with tortoises translocated from the SEA in 2008. (Using Desert Access Guides, compare distribution of ACECs, wilderness areas, National Natural Landmarks in the proposed release areas for WEA tortoises with the existing release areas for the SEA tortoises). The locations and densities of graded and ungraded dirt roads, authorized designated routes and unauthorized motorcycle trails, campgrounds, ACECs, designated wilderness, and hunting sites should be documented, mapped, and included in the revised model. Vehicle traffic on roads and unauthorized off-road vehicle use present risks to tortoises (Keith and Berry 2005; Berry et al. 2008; Boarman and Sazaki 2006; Keith et al. 2008). For example, in 2008 and 2009 at least two of 158 translocated tortoises in the health research program were killed by vehicles on dirt roads and a third translocated tortoise was trapped in its damaged burrow by a person travelling off a designated route during the first nine months post-translocation (Berry et al. 2009). No roads have been fenced to protect tortoises in the areas proposed as release sites in the WETA.

The fieldworkers who walking transects for the preliminary surveys of plots recorded the presence of several unfenced mining shafts or holes—hazards (deaths) to tortoises. The shafts, ordnance, campgrounds, agricultural areas, settlements (including individual dwellings) are other potential hazards. The transects walked as part of the preliminary surveys covered from 2 to 4% of the surface area of plots; thus far more hazards occur on plots than were identified.

Status and Health of Desert Tortoises on the 47 Plots

For the purposes of this discussion, we assume that the data on tortoises, collected from the 47 plots, represent the distribution, relative abundance, status, and health of tortoises in the general area where translocatees from the WEA are likely to be released. Questions to be addressed include, but are not limited to:

- What is the distribution and relative abundance of tortoises in the proposed release area?
- What is the composition of the population (size-age class, sex ratio)? What are mortality rates and causes of death?
- What is the distribution of tortoises with infectious diseases? What is the prevalence of disease and trauma?
- Does the current distribution reflect habitat quality or some other factors? Why do some plots with apparently good habitat for tortoises have few signs of tortoises? What historic information is available for the region for tortoise populations and how do the data assist us in understanding the current condition of the population?
- What is the carrying capacity of the area for tortoises now and in the near future, given the likelihood of climate change and a warmer, drier desert in this part of the Southwest? What are potential effects of releasing several hundred tortoises into this area?

We have preliminary answers to some questions. Data are currently unavailable or insufficient to address all of the questions. Both the counts of tortoise sign and the more comprehensive coverage of 47 plots support several key points:

(1) Sign Counts and Live Tortoises. Sign counts from the comprehensive coverage of 47 plots indicate that tortoises were present in the recent past or are currently present on all plots. Plots can be grouped by level of sign counts from very low to high. Sign counts were very low (0.02–0.07/km of transect) on plots 6, 7, 30, 41, and 61. On these plots, sign consisted of combinations of dead tortoises, inactive burrows or scat; no live tortoises were observed. The next group, plots with low sign (0.12 to 0.30/km of transect) included plots 8, 13, 22, 35, 37, 38, 42, 44, and 45. With one exception (plot 35), all nine plots had 1 to 4 live tortoises, and several had high ratios of dead to live tortoises.

Plots with 0.34 to 0.62 sign/km of transect form the next group with moderate or low moderate levels of sign (16, 17, 19, 23, 25–29, 32, 34, 40, 46, 47, 62, and 64). These plots have from 0 to 7 live tortoises and several have high ratios of dead to live tortoises. The dead tortoises account for a substantial portion of sign on many of these plots. Plots with 0.79 to 0.97 sign/km of transect include 5, 14, 22, 24, 39, and 63. Plots 5, 14, 22, and 63 had from 2 to 5 live tortoises, whereas plots 24 and 39 had 15 and 10 live tortoises, respectively. Plot 24 and 39 may fit better into the group of plots with moderately high numbers of live tortoises (plots 1, 2, 3, 4, 9, 10, 12, 18, 20, 21, and 36).

In general, the plots with moderate to high sign counts and numbers of live tortoises occur primarily between Black Mountain Wilderness on the west and the Copper City Road on the east. This block extends north to the vicinity of Murphy's Well. There are four "outliers" with moderate to high counts of live tortoises to this block: two plots to the east of the Copper City Road (plots 18 and 24) and two plots to the west and south of Superior Dry Lake (plots 36 and 39). Plots with the lower sign counts are in the northwestern, western, and southwestern parts of the study area.

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(2) Counts of Shell-skeletal Remains and Live Tortoises. Shell-skeletal remains of subadult and adult tortoises may persist for many years in the desert. We counted shell-skeletal remains but did not undertake a comprehensive assessment of estimated time since death or cause(s) of death. With this limited information in hand, we can sort the plots into four groups. (The notes below are estimates, given that each set of remains was not analyzed.)

a. Low numbers (0–6) of both live tortoises and shell-skeletal remains, implying very low densities in last 10 years (plots 6, 7, 26, 30, 37, 41, 42, 47, 61-64)

b. No or low to moderate numbers of live tortoises (0–10) but numbers of shell-skeletal remains were also low to moderate (9–23), implying that more tortoises occurred on the site recently but the density was low to moderate in the recent past (plots 5, 8, 16, 18, 25, 33, 34, 38, 40, 44, 45, 46)

c. No or low numbers of live tortoises (0–8) but moderate to high numbers of shell-skeletal remains (30–87), implying that tortoise densities were substantially higher in the last 10 to 20 years (plots 9, 13, 14, 17, 19, 23, 27-29, 32, 35, 37)

d. Numbers of live tortoises ≥ 10 and numbers of shell-skeletal remains ≥30, implying that densities were higher, possibly double, in the last 10 to 20 years (plots 1-4, 10, 12, 20, 21, 24, 36).

Eighteen plots with low counts of live tortoises and low to high counts of shell-skeletal remains occur in the northwestern and western parts of the study area, extending from the NAWS boundaries in the north to Harper Dry Lake in the south (plots 13, 14, 22, 23, 27-29, 34, 35, 37, 38, 41, 42, 44, 61-64). These 18 plots had 31 live tortoises, 10 of which occurred on plots 62 and 63; they also had remains of 483 tortoises, of which only 4 occurred in the northern part of the study area. Thus the land between the Grass Valley Wilderness and Black Mountain Wilderness and land west of the Black Mountain Wilderness had 27 live tortoises and 479 dead tortoises. We can conclude that the tortoise population experienced a die-off in the last 10 to 20 years and that densities are currently very low in this area. Historically, there were probably more tortoises in the area— Berry and Nicholson (1984) showed estimated densities of ≥20 to 50 tortoises/mi^2 lands to the south and west of the NAWS based on a map developed from strip transects walked in the late 1970s.

(4) Composition of the live tortoise population on the 47 plots. During the comprehensive surveys, 267 tortoises were located above and below ground. Of the 267, all but 9 were adults (96.6%). Two hundred forty adults and subadults were evaluated for health; significantly more males were present in the sample than females, a similar pattern observed in samples of tortoises from the SEA (Berry and Mack 2008).

(5) Infectious Diseases—Mycoplasmosis. Of the 240 tortoises, 8.75% had positive or suspect ELISA tests for *M. agassizii* or *M. testudineum* (Figs. 2-3). The protocol for relocation of tortoises from the WEA to the WETA states that 5 km buffer will be drawn around the locations of tortoises with positive and suspect tests for the two species of *Mycoplasma* (Esque et al. 2009). With the 5 km buffer, limited lands for translocation are available to the south of the WEA in the vicinity of plot 8, 16-18, and 24, as well as lands to the west of Pilot Knob and the Black Mountain Wilderness (Fig. 5). If the data set from the 2008 sampling of WETA plots is also used (plots 13, 16, 17, and 19), then the potential area available for translocation is further limited (Fig. 6). We can expect the map to change further, if and when more tortoises with suspect and positive ELISA tests area found in the WEA.

(6) Suitable Habitat and Anthropogenic Impacts. As described earlier, not all the plots have habitat suitable for release of translocated tortoises. Examples include, but are not limited to plots 6 and 7 (adjacent agricultural fields or disturbed grazing lands), 47 (67% playa, also impacts are high) and 41 (vegetation in fair condition, impacts high). Additional maps will be prepared to delineate suitable habitat and different levels of anthropogenic impacts.

RECOMMENDATIONS

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), and the home sites of tortoises compared with potential release sites.

1. We recommend and plan to conduct surveys of vegetation, soils, and topography of the WEA where the potential translocatees are now living. The survey will include belt or line transects of perennial vegetation with an objective of obtaining data on cover values and composition. Vegetative communities will be mapped, or previous maps, if appropriate for use to describe desert tortoise habitat, will be checked. Data, similar or identical to the data collected on elevations, topography, surficial geology, predator sign counts, and anthropogenic impacts for the 47 plots, will be collected where the potential translocatees are currently living. The data will be analyzed and compared with data from the proposed release areas. With this information, scientists and decision-makers can develop a better understanding of the similarities and differences of current tortoise home sites with the areas considered for release. Answers can be developed for such questions as: do habitats at home sites of the potential translocatees match habitats in the proposed release areas? If not, how much do the habitats differ? Are the habitats that now have very low numbers of tortoises to the west and south of Pilot Knob and Cuddeback Dry Lake have lowered carrying capacity compared with the past? In the

latter case, review of historical journal notes and photographs may provide valuable information.

2. The topic of available forage for tortoises has not been adequately addressed. The 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. We propose to undertake this effort in spring of 2010.

3. At the Ft. Irwin science meetings, some scientists and agency personnel have raised the topic of a dispersed release of the translocated tortoises throughout the entire WEA instead of using a clustered release on plots, as was done in the SEA translocation in 2008. This approach is a different experiment than what was done previously for the SEA tortoises and will require hypothesis testing and a research program to monitor the success.

4. We need to have a better understanding why tortoises are absent or virtually absent from some areas in the Central Mojave Desert. We can make the assumption that populations have experienced similar declines to the populations on long-term permanent plots to the west, northwest, and south (Berry and Medica 1995). We can also assume that the causes of decline are numerous, cumulative, and similar to those recorded earlier for the western, central and southern Mojave (U.S. Fish and Wildlife Service 1994). Examples include mycoplasmosis and other diseases, drought and starvation, predation by ravens, road kills, vandalism, a change in the composition of available food compared with preferred forage species, and trauma from domestic dogs (e.g., Jacobson et al. 1991, 1994; Berry 1986; Boarman 1993; Boarman and Berry 1995; Christopher et al. 2003; Homer et al. 1998; Brown et al. 1999; Jennings 1997; Berry et al. 1986, 2002, 2006b, 2008; Kristan and Boarman 2003; Keith and Berry, 2005; Boarman and Sazaki 2006; Brooks and Berry 2006, Brooks et al. 2006; Johnson et al. 2006; Keith et al. 2008; Carlson et al. in review).

From our preliminary evaluation of the data from the 48 plots as well as the data collected in 2008 using different sample sites, we can obtain a better understanding of historical and current issues by mapping and modeling the distribution and densities of the tortoises, the habitat types, results of disease and health sampling, and the many different types of anthropogenic impacts. We plan to undertake this effort using the existing data sets in 2010.

5. For the analysis of anthropogenic impacts, we will re-evaluate and weight the anthropogenic impacts. For example, roads will be separated by type: paved, dirt with high berms and high use, dirt with low berms and high use, low use dirt roads, authorized and unauthorized motorcycle trails, etc. The Copper City Road, for example, has high berms in some areas and has been observed to trap tortoises within the road bed. Recreation areas (e.g., Inscription Canyon, Fossil Beds, Cuddeback Dry Lake and

Superior Dry Lake) where people concentrate will be included, as well as agricultural fields, where active or abandoned. The locations of individual homes and settlements will be part of the analysis. Likewise, the volcanic fields and small lakebeds will be identified, even if relatively small, and treated as potentially hazardous areas.

6. As time permits, the shell-skeletal remains on the existing plots should be re-evaluated for time since death, size-age class, and potential causes of death.

7. Prior to translocation, mining and other hazards should be fenced to exclude tortoises.

8. The current and most up-to-date literature on climate change projections forecast a drier Mojave Desert. It is essential the climate change be considered as a potential factor in at least one of the revised models.

9. An increase in infectious disease(s) should be considered as part of the revised model, based on experiences from the SEA translocation in 2008.

ACKNOWLEDGEMENTS

Dr. Mary Brown and Dr. Lori Wendland are collaborators on this project, provided valuable advice on interpretations, and will be co-authors on any future publications for the open literature. Dr. Elliott Jacobson, also of the University of Florida, a pathologist, will be recognized or co-authors on appropriate future publications. The field team, headed by K. Anderson included: I. Alexakos, A. Al-Hadad, C. Bedwell, S. Boisvert, J. Boswell, L. Chow, A. DeMartini, C. Furman, M. Giovanini, S. Hanner, C. Hatton, J. Hillman, T. Hockin, E. Holle, J. Holloway, T.G. Jackson, J. Kayser, A. Keller, K. Kermoian, P. Kermoian, B. Kirkpatrick, K. Lucas, R. McGuire, T. Ose, K. Palmer, T. Rasmussen, B. Sandstrom, A. Schaub, A. Scheib, C. Spake, A. Spenceley, B. Vickers, S. Todd, K. Walsh, and Walters. Marcella Waggoner and Nate Newman entered data and performed quality controls on data sets; Tim Gowan generated maps. Kristina Drake coordinated fieldwork with USGS scientists at the Las Vegas Field Station. Thanks are due to K. Phillips, T. Gowan, and R. Jones, for reviews, and to C. Everly for advice. The National Training Center, Ft. Irwin, provided financial support.

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Table 1. A summary of tortoise sign found during preliminary surveys of 45 plots sampled during 2009. All sign includes live tortoises as well as other sign.

				Number of tortoises and tortoise sign					
Plot no.	**Transect distance (km)**	**All sign/km**	**Live tortoises/km**	**Live**	**Dead**	**Active burrows**	**Inactive burrows**	**Scats**	**Other**
1	11	3.909	0.000	0	0	1	6	36	0
2	11	2.273	0.000	0	0	0	12	13	0
3	8.7	2.184	0.114	1	4	1	11	2	0
4	11	2.818	0.000	0	2	1	12	16	0
5	11	1.273	0.000	0	1	0	6	7	0
6	6.4	0.000	0.000	0	0	0	0	0	0
7	6.4	0.000	0.000	0	0	0	0	0	0
8	11.0	0.546	0.000	0	4	0	2	0	0
9	11.7	1.795	0.171	2	3	2	7	7	0
10	11	1.909	0.091	1	0	2	13	5	0
12	11	4.091	0.091	1	2	3	25	12	2
13	11.0	0.364	0.000	0	3	1	0	0	0
14	11	0.182	0.000	0	1	0	1	0	0
16	11	0.273	0.000	0	2	0	1	0	0
17	10.1	0.198	0.000	0	2	0	0	0	0
18	11	1.000	0.091	1	0	0	5	5	0
19	11	0.455	0.000	0	2	1	1	1	0
20	11	2.818	0.091	1	3	3	12	11	0
21	11	3.000	0.182	2	5	2	11	13	0
22	8.7	0.804	0.000	0	1	1	2	3	0
23	11	0.636	0.000	0	1	2	2	2	0
24	8.7	0.920	0.000	0	3	3	1	1	0
25	11.0	0.727	0.091	1	0	1	0	5	1
26	11.0	1.091	0.091	1	1	4	4	2	0
27	8.7	0.460	0.000	0	3	0	0	1	0
28	7.3	0.411	0.000	0	2	0	1	0	0
29	8.7	0.345	0.000	0	3	0	0	0	0
30	11	0.000	0.000	0	0	0	0	0	0
32	11	0.636	0.000	0	1	1	4	1	0
33	11	0.364	0.000	0	2	0	2	0	0
34	11	0.273	0.000	0	1	0	2	0	0
35	11	0.182	0.000	0	2	0	0	0	0
36	6.4	0.469	0.000	0	2	0	1	0	0
37	8.7	0.345	0.000	0	0	0	1	2	0
38	8.7	0.115	0.000	0	1	0	0	0	0

Table 1, continued. A summary of tortoise sign found during preliminary surveys of 45 plots sampled during 2009. All sign includes live tortoises as well as other sign.

				Number of tortoises and tortoise sign					
Plot no.	**Transect distance (km)**	**All sign/km**	**Live tortoises/km**	**Live**	**Dead**	**Active burrows**	**Inactive burrows**	**Scats**	**Other**
39	8.7	0.229	0.000	0	1	0	1	0	0
40	6.4	0.469	0.000	0	1	0	1	1	0
41	8.7	0.000	0.000	0	0	0	0	0	0
44	8.7	0.345	0.000	0	0	0	2	1	0
45	8.7	0.000	0.000	0	0	0	0	0	0
47	5.3	0.755	0.000	0	0	0	0	4	0
61	8.7	0.000	0.000	0	0	0	0	0	0
62	8.7	0.345	0.000	0	0	0	1	2	0
63	6.4	0.313	0.000	0	0	0	1	1	0
64	10.5	0.095	0.000	0	0	0	1	0	0
Totals	**432**	**0.947**	**0.026**	**11**	**59**	**29**	**152**	**154**	**4**

Table 2. A summary of predators and predator sign by plot for surveys undertaken in 2009

Plot no.	Transect (km)	Sign/km	Total sign	Number of predators or predator sign					
				Ravens	Live canid/ felid	Canid scats	Canid dens	Sign concen-tration areas	Other sign, not included in counts: digs, howling coyotes, and barking dogs
1	11	2.45	27	0	0	20	0	0	7 bobcat scats
2	11	1.45	16	0	0	13	0	2	Also: 1 domestic dog scat
3	8.7	1.26	11	0	0	9	0	2	2 sign concentration areas are bobcat
4	11	2.54	28	4	0	18	0	3	Also: 3 domestic dog scats
5	11	2.00	22	0	0	12	1	6	Also: 3 domestic dog scats
6	6.40	0.94	6	0	0	6	0	0	approximately 10 canid digs, dogs barking, dogs living at nearby home
7	6.40	7.97	51	20	1	~30	0	0	dog kennels nearby (>100 dogs); >6 domestic dog scats; 6 canid dig sites; considerable dog scat along roads and fenceline
8	8.7	3.22	28	0	0	28	0	0	> 40 digs; several coyotes howling just north of plot
9	11.70	1.71	20	0	0	15	0	5	~35 canid dig sites
10	11	0.36	4	0	0	3	0	1	
12	11	1.09	17	0	0	13	1	31	
13	8.7	1.37	12	0	0	7	5	0	>50 canid dig sites
14	11	0.636	7	0	0	5	0	2	
16	8.7	1.72	15	0	0	14	0	1	>50 canid dig sites
17	8.7	1.03	9	0	0	7	0	2	>50 canid dig sites
18	8.7	1.38	12	0	0	6	0	6	~ 55 canid dig sites
19	8.7	1.15	10	0	0	9	0	1	~ 35 canid dig sites
20	8.7	1.26	11	0	0	8	3	0	>50 canid dig sites
21	8.7	1.15	10	0	0	10	0	0	>45 canid dig sites; coyotes calling
22	8.7	0.69	6	0	0	6	0	0	Also, 1 domestic dog scat,far from dirt road

Table 2, continued. A summary of predators and predator sign for plots surveyed in 2009

Plot no.	Transect (km)	Sign/ km	Total sign	Number of predators or predator sign					
				Ravens	Live canid/ felid	Canid scats	Canid dens	Sign concen-tration area	Other sign, not included in counts: digs, howling coyotes, and barking dogs
23	11.0	1.64	18	2	0	10	1	5	
24	8.70	1.61	14	0	0	12	0	2	>60 canid dig sites and mine shaft with 1 barn owl and 2 eggs
25	8.70	1.38	12	0	0	12	0	0	> 50 canid dig sites
26	8.70	1.49	13	0	0	13	0	0	>50 canid dig sites
27	8.70	2.18	19	0	0	3	16	0	~8 digs, prints of domestic dogs
28	7.30	0.82	6	1	0	3	0	2	~15 canid dig sites; coyotes howling
29	8.70	1.38	12	0	0	9	0	3	~ 50 canid dig sites and 1 falcon w/nest
30	8.70	0.80	7	0	0	5	2	0	~ 40 canid dig sites
32	8.70	0.23	2	0	0	2	0	0	> 50 canid dig sites
33	8.70	1.61	14	1	0	10	0	3	~ 50 canid dig sites
34	8.70	2.18	19	0	0	14	0	5	> 50 canid dig sites
35	8.70	2.76	24	0	0	17	0	7	~50 canid dig sites and kit fox tracks
36	6.40	0.47	3	0	0	3	0	0	~70 canid dig sites, remains of 1 jack rabbit
37	8.70	0.34	3	0	0	3	0	0	6 canid dig sites
38	8.70	0.34	3	0	0	3	0	0	37 canid dig sites
39	8.70	1.49	13	0	0	11	1	1	56 canid dig sites
40	6.40	1.88	12	0	0	11	0	1	~45 canid dig sites and 1 bobcat den with kittens
41	8.70	0.69	6	0	0	4	0	2	~40 canid dig sites
44	8.70	1.15	10	1	0	6	0	3	1 inactive raven/raptor nest site in Joshua tree; ~40 canid dig sites
45	8.70	1.72	15	0	0	15	0	0	26 canid dig sites

Plot no.	Transect (km)	Sign/ km	Total sign	Number of predators or predator sign Ravens	Live canid/ felid	Canid scats	Canid dens	Sign concen-tration areas	Other sign, not included in counts: digs, howling coyotes, and barking dogs
47	5.3	1.32	7	0	0	6	0	1	~20 canid dig sites
61	8.70	1.26	11	0	0	10	0	1	many canid tracks; ~24 dig sites
62	8.70	1.03	9	0	0	8	0	1	>24canid dig sites
63	6.40	0.63	4	0	0	4	0	0	>50 canid dig sites
64	8.7	1.26	11	1	0	10	0	0	>50 canid dig sites

Table 3. 2009, Suitability of plots as tortoise habitat: a summary of vegetation notes relevant to potential translocation of desert tortoise.

Plot No.	Dominant and common shrubs	Quality of vegetation; initial notes on limitations or problems
1	Joshua trees (*Yucca brevifolia*) are sparse; burro bush is dominant in numbers; other common shrubs include creosote bush, goldenhead (*Acamptopappus sphaerocephalus*), big galleta grass (*Pleuraphis rigida*), winterfat (*Kraschen-innikovia lanata*) and California scale broom (*Lepidospartum squamatum*).	Good. Perennial plants (24 spp.) moderately diverse. *Brassica* spp. and *Bromus* spp. are common, *Amsinckia* is ubiquitous outside of washes. Wash vegetation: California scale broom, rabbit brush (*Ericameria nauseosa*), and matchweed (*Gutierrezia* spp.)
2	The common perennial plants are big galleta grass, burrobush, creosote bush, peach thorn (*Lycium cooperi*), and winterfat. Joshua trees are rare.	Good. Perennial plants (19 spp.) moderately diverse. *Brassica* spp. are common.
3	The common perennial plants are burro bush, creosote bush, peach thorn, big galleta grass, peach thorn, and shadscale (*Atriplex confertifolia*). Joshua trees are sparse.	Fair to poor. Perennial plants (33 spp.) are diverse, including paperbag bush (*Salazaria mexicana*), desert straw (*Stephanomeria pauciflora*), matchweed, and California scale broom in washes. *Brassica* spp. are rare.
4	Burrobush is the dominant shrub. Other common plants include big galleta grass, creosote bush, peach thorn, and cheese bush (*Hymenoclea salsola*). Joshua trees and Mojave yuccas (*Yucca schidigera*) are rare.	Good. Perennial plants (25 spp.) are present. *Bromus* spp are common; *Brassica* spp. are sparse. Three washes dominated by California scale broom, rabbit brush, and cheese bush.
5	Common perennial plants include: big galleta grass, burrobush, creosote bush, cheese bush, and goldenhead. Joshua trees are rare..	Fair to good. Cover of perennial plants (18 spp.) is sparse. History of cattle grazing may have affected quality and composition of vegetation.
6	Allscale (*Atriplex polycarpa*) is dominant, other shrubs include: burro bush, cheese bush, and creosote bush. Russian thistle is also common.	Very poor. 16 spp. of perennial plants noted. Habitat quality is extremely poor due to grazing and fires. Plot adjacent to old agricultural field and residence; boundary lies between graded dirt road and tumbleweed (*Salsola* spp.)-piled private property fence. Few shrubs present; allscale is indicative of alkaline soils and/or disturbance, cheese bush is associated with disturbed sites.
7	Allscale is the predominant species, followed by four-wing saltbush (*Atriplex canescens*), peach thorn, burrobush, and shadscale.	Poor. The plot lies on uniform valley floor and has few shrubs (8 spp.). *Shismus* spp*.* inhabits the inter-shrub space. Evidence of intense past livestock grazing is pervasive. Habitat unsuitable for translocation.
8	Cheesebush is dominant; other common shrubs include Cooper's goldenbush, spiny hopsage (*Grayia spinosa*), creosote bush, turpentine bush (*Thamnosma montana*), and Mojave horsebrush.(*Tetradymia stenolepis*)	Fair to Good. Joshua trees are relatively numerous though not common. 24 spp. of shrubs present. Cheese bush and Cooper's golden bush are indicators of past livestock grazing pressure. Cheese bush is also associated with disturbed sites.
9	Burro bush is the dominant shrub; other common shrubs include creosote bush, indigo bush (*Psorothamnus arborescens, P. fremontii*) cheese bush, and winterfat. Joshua trees present but sparse.	Good; 31 spp. of perennial shrubs, cacti, and grass. Vegetation is diverse and healthy looking. Cheese bush is a pioneer species and is often associated with disturbed sites.
10	Burro bush is dominant; other common shrubs include creosote bush, cheese bush, shadscale, and Mojave woody aster (*Xylorhiza tortifolia*).	Good. *Brassica* spp. are present; *Bromus* spp are common. Perennial plants, 28 spp. noted. Joshua trees are rare.

Table 3, continued: 2009, Suitability of plots as tortoise habitat: a summary of vegetation notes relevant to potential translocation of desert tortoise.

Plot No.	Dominant and common shrubs	Quality of vegetation; initial notes on limitations or problems
12	Creosote bush is the dominant shrub. Other common shrubs are burrobush, shadscale, peach thorn and paper bag bush are more common in washes. Joshua trees are present but rare.	Good. *Brassica* spp. are sparse. Perennial plants—21 species noted. The presence of saltbush is indicative of alkaline soils.
13	Vegetation is almost exclusively allscale saltbush. Burrobush is present but much less abundant, followed by sparsely distributed winter fat, cheesebush and *Tetradymia*	Poor. Vegetation is almost a monoculture of allscale, indicative of alkaline soils and/or disturbance (12 spp. of perennial plants present). The plot supports few other shrubs and is poor quality habitat for tortoise.
14	Burrobush and creosote bush are by far the most common shrubs across the plot, followed by allscale, spiny hopsage, and cheese bush (washes). Three species of salt bush are present; allscale dominates the SW quarter of the plot	Fair to good. 14 spp. of perennial plants are present. Few shrubs in the intershrub spaces between creosote bush and burro bush with the exception of alien annual plants.
16	Creosote bush is the dominant shrub; other common shrubs include burrobush, spiny hopsage, cheese bush, and peach thorn. Joshua trees are present and sparse.	Good to Fair. 29 spp. perennial plants. The south and east ends of the plot have diverse and closely spaced vegetation; the north and west portions have decreased diversity and increased spacing between shrubs.
17	Creosote bush is dominant; other common shrubs include burro bush, spiny hopsage, winterfat, goldenhead, and Nevada joint fir. Joshua trees sparsely distributed.	Good. 24 spp. of perennial plants. Large Joshua trees and fairly dense vegetation characterize the southern end of the plot. In the north, vegetation is more widely spaced.
18	Burro bush is dominant; other common shrubs include spiny hopsage, creosote bush, goldenhead and winterfat. Joshua trees present but sparse.	Good. 28 spp. of perennial plants. Shrub mixture is fairly diverse and varies throughout the plot. The plot appears to be a promising relocation spot.
19	Creosote bush is dominant; other common shrubs include burro bush, cheese bush, Cooper's golden bush, and turpentine bush. Joshua trees are present but sparse.	Good. 31 spp of perennial plants. A variety of terrain supports diverse vegetation. The presence of Cooper's golden bush indicates past livestock grazing pressure. Cheese bush is also a pioneer species associated with disturbed sites.
20	Burrobush and creosote bush are co-dominants across the plot; allscale also common. One or 2 Joshua trees on the plot.	Fair to Poor. 20 spp. of perennial plants. Vegetation in wash and in SE corner is diverse and healthy. In all other areas, shrubs are widely spaced.
21	Burrobush is the dominant shrub; common shrubs include creosote bush, turpentine bush, cheese bush, and paper bag bush. Joshua trees and Mojave yuccas rare.	Good to excellent. 28 spp. of perennial shrubs, cacti, and grasses. Cheese bush is a pioneer species often associated with disturbed sites.
22	Burrobush and creosote bush are common shrubs, followed by allscale, indigo bush, cheese bush, and shadscale. Joshua trees are rare.	Fair to good. 27 spp. of perennial plants. Some significant washes with *Brickellia incana*, California scalebroom, sandpaper plant (*Petalonyx thurberi*).

Table 3, continued: 2009, Suitability of plots as tortoise habitat: a summary of vegetation notes relevant to potential translocation of desert tortoise.

Plot No.	Dominant and common shrubs	Quality of vegetation; initial notes on limitations or problems
23	Burro bush and creosote bush are the more common shrubs, followed by Anderson thornbush (*Lycium andersonii*), indigo bush, and goldenhead.	Good. 12 spp. of perennial plants are present.
24	Creosote bush is dominant; other common shrubs include burro bush, cheese bush, allscale and shadscale. Joshua trees and Mojave yuccas are present but sparse.	Fair to poor. 26 spp. perennial shrubs, cacti, and grasses. The plot has substantial historic disturbance from mining, bulldozing, and human habitation. Allscale and cheese bush, pioneer species often associated with disturbed sites, may be indicators of historic disturbances.
25	Burro bush is the dominant shrub; common shrubs include cheese bush, creosote bush, spiny hopsage, and winterfat. Joshua trees present but rare	Poor to fair. 30 spp. of perennial plants are present. The bajada to the north is rocky and vegetated almost exclusively by creosote bush. To S and E, valley floor has poor habitat with low, sparse, and stunted shrubs. The N and W portions support a mix of vegetation and appeared to be better habitat.
26	Creosote bush is dominant; common shrubs include burro bush, cheese bush, Nevada joint fir (*Ephedra nevadensis*), and California buckwheat (*Eriogonum fasciculatum*).	Good to Fair. 28 spp. of perennial plants. Cheese bush is a pioneer species often associated with disturbed sites.
27	Burro bush is the dominant shrub; common shrubs include creosote bush, cheese bush, indigo bush, and allscale. Joshua trees present and rare.	Good; 29 spp. of perennial plants. This plot has a good mix of suitable soils and a variety of vegetation.
28	Creosote bush is dominant; common shrubs include: burro bush, cheese bush, allscale, and Nevada joint fir. Joshua trees are present but rare.	Poor. 32 spp. of perennial plants are present Poor terrain with limited sites for tortoise burrows. The presence of saltbush is indicative of alkaline soils on at least part of the plot.
29	Creosote bush is dominant; common shrubs include burro bush, cheese bush, allscale, and Nevada joint fir.	Poor. 39 ssp. of perennial plants are present.The SE part of plot is steep, very rocky, and apparently not suitable for use by tortoises. The rest would, at best, be low density habitat. The best habitat available on this plot is highly impacted by OHV use.
30	Creosote bush and burro bush are co-dominant; less common are cheese bush, Anderson thorn bush, and peach thorn. Joshua trees and Mojave yucca are present but sparse	Fair to Poor. 21 spp. perennial plants present. Vegetation on >90% of plot consists of widely spaced creosote bush with few to no shrubs between. Vegetation between shrubs is almost exclusively *Erodium, Schismus* and *Amsinckia*.

Table 3, continued: 2009, Suitability of plots as tortoise habitat: a summary of vegetation notes relevant to potential translocation of desert tortoise.

Plot No.	Dominant and common shrubs	Quality of vegetation; initial notes on limitations or problems
32	Creosote bush is dominant; common shrubs include burro bush, cheese bush, turpentine bush, and Mojave horse brush. Mojave yucca and Joshua trees are present but rare.	Fair to Good. 32 spp. of perennial plants present. Vegetation is creosote bush and a mix of other shrubs. S plot: widely spaced creosote bush and other shrubs are sparse to rare. N plot: poor habitat. Cheese bush is a pioneer species often associated with disturbed sites.
33	Creosote bush is dominant; common shrubs include burro bush, cheese bush, turpentine bush and Nevada joint fir. Mojave yucca is sparse, Joshua trees are rare.	Good. 29 spp. perennial plants; cheese bush is a pioneer species often associated with disturbed sites.
34	Creosote bush is dominant shrub; common shrubs include: burro bush, cheese bush, Nevada joint fir, and indigobush. Joshua trees and Mojave yucca are present and rare.	Good. 25 spp. perennial plants; cheese bush is a pioneer species often associated with washes and human-related disturbed lands.
35	Creosote bush is dominant; common shrubs burro bush, cheese bush, turpentine bush, and Nevada joint fir. Joshua trees are present but rare.	Good to fair. 28 spp. of perennial plants. Cheese bush was the third most common shrub and is a pioneer species associated with washes and disturbed sites.
36	Allscale saltbush is dominant shrub; common shrubs include shadscale, apricot mallow, cheese bush, and Anderson thorn bush.	Fair to Poor. 27 spp. of perennial plants. Most of plot, except central areas, lacks suitable habitat. Saltbush species and proximity to Superior Lake playa are indicative of alkaline soil. The interior of the plot appears to be more suitable.
37	Creosote bush is dominant; common shrubs include spiny hopsage, Cooper's goldenbush, turpentine bush, and Nevada joint fir. Joshua trees present but sparse	Fair. 26 spp. perennial plants. About half the plot supports a variety of perennial shrubs with the other half supporting more open and sparse vegetation. The presence of Cooper's golden bush and cheese bush indicates past disturbance, e.g., livestock.
38	Creosote bush is dominant; common shrubs include spiny hopsage, Cooper's goldenbush, burro bush, and Anderson thornbush. Joshua trees are present but sparse.	Fair to poor. 28 spp. of perennial plants. The presence of Cooper's golden bush is indicative of past livestock grazing pressure.
39	Creosote bush is dominant; common plants include Cooper's goldenbush, burro bush, Anderson's thornbush, and spiny hopsage.	Fair to poor. 25 spp. of perennial plants. The presence of Cooper's golden bush is indicative of past livestock grazing pressure.
40	Allscale saltbush is the dominant shrub; other common shrubs are Anderson's thorn bush, spiny hopsage, winterfat, and burrobush.	Poor. 26 spp. of perennial plants. Plot consists of low valley floor with sparse, low vegetation Saltbush is dominant on part of plot, indicating the existence of alkaline soils. The north end appears to be contiguous with more productive habitat north of the plot.

Table 3, continued: 2009, Suitability of plots as tortoise habitat: a summary of vegetation notes relevant to potential translocation of desert tortoise.

Plot No.	Dominant and common shrubs	Quality of vegetation; initial notes on limitations or problems
41	Creosote bush is the dominant shrub; common shrubs include Nevada joint fir, Cooper's goldenbush, Anderson's thornbush, and turpentine bush. Joshua trees are rare.	Fair. 23 spp of perennial shrubs and grasses. Cooper's golden bush and cheese bush are indicative of past livestock grazing pressure.
44	Creosote bush is dominant overall; other common plants include burro bush, cheese bush, Cooper's goldenbush, and Nevada joint fir.	Good to fair. 30 spp. of perennial plants. This plot consists of low hills, bajada, and valley floor, with a diverse plant assemblage. Cooper's golden bush and cheese bush indicate past livestock grazing pressure.
45	Creosote bush is the dominant shrub; common shrubs are turpentine bush, Cooper's goldenbush, burro bush, and California buckwheat.	Good to Fair. 29 spp of perennial plants. The presence of Cooper's golden bush indicates possible past livestock grazing pressure.
47	Allscale saltbush is the dominant shrub; common plants are shadscale, Anderson's thornbush, apricot mallow, and desert alyssum.	Very poor. 14 spp. of perennial plants. The majority of the plot is bare playa. The saltbush species are indicative of alkaline soils.
61	Creosote bush is dominant; common plants include burro bush, Cooper's goldenbush, cheese bush, and blackbrush. Joshua trees present and rare.	Good to Fair. 27 spp. of perennial plants. Cooper's golden bush and cheese bush are often indicative of past livestock grazing pressure. Matchweed also present.
62	Creosote bush is dominant; common plants include burro bush, Cooper's goldenbush, Anderson's thornbush and spiny hopsage. Joshua trees are present and rare.	Good to Fair. 27 spp of perennial plants. Cooper's golden bush and cheese bush, common indicators of past livestock grazing pressure, are common.
63	Creosote bush is dominant; common plants include burro bush, cheese bush, Mojave aster, and Anderson thorn bush.	Good to Fair.17 spp. The indicators of substantial historical grazing are present, e.g., cheese bush.
64	Creosote bush is dominant; common plants include: burro bush, Cooper's goldenbush, cheese bush, and spiny hopsage. Joshua trees are present but sparse.	Good to Fair. 26 spp. on uniform valley floor. The presence of Cooper's golden bush and cheese bush are indicators of past livestock grazing pressure.

Table 4. Suitability of plots as tortoise habitat: topography and surficial geology.

Plot No.	Elevations (m)	Topography: % of plot suitable for tortoises	Surficial geology: % of soils and soil surfaces suitable for easy to moderate		Notes on topography and suitability of soils for walking and digging burrows
			Walking	Digging	
1	725-774	98	100	100	The topography on 86% of the plot is alluvial fan; soils suitable for digging are on 100%. There are three significant washes and two areas with steep banked canyons (2% steep canyon walls, unsuitable for tortoises).
2	664-689	98	100	100	This plot is composed of 95% gently sloping alluvial fan with 3% large wash and 2% washlets.
3	884-946	50	55	75	This plot has varied topography including rolling hills, badlands, washes, and alluvial fan with soils suitable for digging. About 45% of the plot is unsuitable for tortoises to walk due to steep or rocky surfaces and 25% is unsuitable for digging burrows
4	738-780	98	98	100	Topography includes gently sloping alluvial fan and several washes with soils suitable throughout for burrows. About 2% is unsuitable for walking due to steep wash banks.
5	677-719	100	100	100	Topography includes gently sloping alluvial fan and several washes. Soil is suitable for burrows. About 1% of the plot has steep banks on washes, presenting minor obstacles.
6	640-792	96	96	96	Valley floor, uniform and almost flat, except the northeast corner, which is part of the Black Mtn Wilderness Area (a steep volcanic field). 4% too steep and rocky for walking and would not support burrows.
7	622-628	100	100	100	Valley floor: 100% suitable for walking or digging.
8	1085-1158	100	100	98	90% alluvial fan and 10% low rolling hills. Easy to moderate walking and digging; only 1% not suitable for digging.
9	1036-1092	30	100	30	90% low rocky slopes, moderate difficulty for walking; 60% rocky soil –moderate to difficult digging; 10% unsuitable for digging
10	604-689	100	98	100	2% steep rocky surface. The topography is primarily alluvial fan with low hills and several washes and washlets draining through the bajada. Soil is suitable for burrows. Only 2% has steep, rocky surfaces, difficult for walking.
12	768-829	100	100	100	This plot consists of gently sloping bajada with several washes. Soil is suitable for burrows.
13	625-671	100	100	100	Valley floor; soils sandy to clay-loam; 5% is a low unvegetated area.
14	655-695	100	100	100	The topography is alluvial fan ~12% in large and small washes. Soils are suitable for burrow construction and surficial geology is suitable for easy walking,

Table 4, continued. Suitability of plots as tortoise habitat: topography and surficial geology.

Plot No.	Elevations (m)	Topography: % of plot suitable for tortoises	Surficial geology: % of soils and soil surfaces suitable for easy to moderate		Notes on topography and suitability of soils for walking and digging burrows
			Walking	Digging	
16	1055-1156	97	96	95	40% alluvial fan, 57% gentle and rolling hills, and 3% very steep.
17	1030-1091	100	100	99	Primarily alluvial fan, valley floor; < 1% unsuitable for digging burrows
18	1067-1097	100	100	99	Alluvial fan/valley floor; < 1% unsuitable for digging burrows
19	1006-1177	75	85	75	10% steep slopes, 5% cliffs; 15% very rocky surfaces, unsuitable for digging burrows and very difficult for walking
20	811-853	98	98	98	Primarily valley floor with large washes; 2% volcanic field; 2% very rocky surface, unsuitable for digging burrows
21	914-945	90	90	90	90% is alluvial fan/valley floor with washes; 10% very rocky surface difficult for walking and unsuitable for digging burrows
22	747-884	97	97	97	3% large boulders; The topography on 97% of plot is alluvial fan and rolling hills suitable for walking and digging. Washes are present (12%); 3% is too steep with large volcanic boulders (unsuitable for tortoises).
23	713-786	100	100	100	The topography is 96% alluvial fan with rolling hills and small washes; soils are suitable for walking and digging.
24	1030-1168	80	92	80	Primarily alluvial fan and valley floor, low hills; 5% steep cliffs; 8% rocky, difficult for walking; 20% unsuitable for digging burrows
25	1030-1109	80	100	80	20% soil with gravel and cobbles present moderate to difficult for digging burrows
26	908-1036	85	99	85	Almost entirely low, rolling hills with minor obstacles; 1% volcanic field-difficult for walking; 15% unsuitable for digging burrows
27	835-920	70	70	90	Mixed habitat: alluvial fan, rolling hills, large and small washes: 30% very rocky surface, difficult for walking, 10% unsuitable for digging burrows
28	872-975	25	25	25	75% steep, deeply ridged “badlands” with rocky surface difficult to walk and unsuitable for digging burrows
29	884-945	75	85	65	15% volcanic field, rocky and very difficult to walk; 85% low hills with large ash deposits and minor obstacles for walking; 35% unsuitable for digging burrows
30	985-1018	100	95	98	95% alluvial fan, 5% rolling hills. 5% minor obstacles for walking; 2% unsuitable for digging burrows

Table 4, continued. Suitability of plots as tortoise habitat: topography and surficial geology

Plot No.	Elevations (m)	Topography: % of plot suitable for tortoises	Surficial geology: % of soils and soil surfaces suitable for easy to moderate		Notes on topography and suitability of soils for walking and digging burrows
			Walking	Digging	
32	1036-1177	~50	90	20	Primarily alluvial fan and rolling hills; 10% with large boulders or steep slopes making walking difficult; 70% with minor obstacles for walking; 70% gravelly to rocky loam, moderate to difficult digging; 10% unsuitable for digging burrows
33	1140-1195	90	99	90	Rolling hills (low) with occasional large boulders (1%); 1% difficult for walking; 10% unsuitable for digging burrows
34	969-1006	~80	100	65	100% low rolling hills and small washes. 98% low hills with minor obstacles for walking; 30% soil has gravel/cobble and poses moderate difficulty for digging; 5% unsuitable for digging burrows
35	945-1022	~90	100	90	65% low hills, 20% large washes and 15% alluvial fan; 65% with minor obstacles for walking; 10% unsuitable for digging burrows
36	914-924	75	75		2% associated with playa and old lake beds; 23% gravel/cobble desert pavement minor obstacles for walking; 25% unsuitable for digging burrows
37	969-1027	100	100	100	50% low rolling hills, 50% valley/alluvial fan
38	1006-1157	80	80	90	80% rolling hills and alluvial fans; 18% boulders or steep cliffs; 20% steep rocky cliffs or rocky surface very difficult for walking; 10% unsuitable for digging burrows
39	945-997	75	75	95	Primarily valley/alluvial fan and rolling hills with10% rocky hills; 25% rocky surface very difficult for walking; 5% unsuitable for digging burrows
40	945-945	99	99	99	Primarily alluvial fan and rolling hills; 1% associated with small playas; 1% rocky –navigable but unsuitable for digging burrows
41	1036-1061	95	95	95	Primarily alluvial fan and rolling hills; 5% rocky areas pose moderate difficulty for walking; 5% unsuitable for digging burrows
44	1006-1067	90	90	90	Predominantly alluvial fan with rolling hills and washlets; 10% hills with minor obstacles for walking; 10% unsuitable for digging burrows
45	1024-1109	70	70	90	90% of plot is valley and alluvial fan, 10% is steep cliffs; 30% steep and/or rocky surface very difficult for walking; 10% unsuitable for digging burrows
47	917-917	<33	100	67	67% of plot is playa; remaining is valley floor. While the soils and surface are suitable for digging and walking, tortoises do not construct burrows in playas
61	1055-1122	96	96	98	Primarily alluvial fan with 4% rolling hills and 1% washlets; 4% hills with rocks –difficult for walking; 2% unsuitable for digging burrows

Table 4, continued. Suitability of plots as tortoise habitat: topography and surficial geology

Plot No.	**Elevations (m)**	**Topography: % of plot suitable for tortoises**	**Surficial geology: % of soils and soil surfaces suitable for easy to moderate**		**Notes on topography and suitability of soils for walking and digging burrows**
			Walking	Digging	
62	1018-1205	70	80	70	85% of plot is alluvial fan and low rolling hills with washlets. 15% steep cliffs; 20% steep and/or rocky surface very difficult for walking; 30% unsuitable for digging burrows
63	939-1000	100	100	100	Uniform alluvial fan with a few small washes (1%); overall easy digging; occasional small boulders present
64	1067-1189	100	100	100	Alluvial fan with 1% rolling hills; gentle slopes and good digging

Table 5. A summary of anthropogenic impacts recorded on transects from 45 one-square mile plots in the Western Expansion Translocation Area, in 2009. All sign counts have been converted to sign per kilometer of transect.

Types of anthropogenic impacts	Number of impacts/km of plot by plot identification number									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Cattle scat	2.09	4.27	1.84	7.09	8.00	37.97	111.41	0.57	0.00	0.64
General garbage	4.64	46.18	0.23	2.27	19.90	10.16	22.50	3.33	5.75	12.27
Balloons	0.82	0.82	0.46	0.73	0.82	0.31	0.47	0.69	0.69	0.82
Firearm casings/targets	0.27	0.00	0.11	0.09	11.82	1.25	0.31	1.15	0.46	1.09
People or footprints	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00
Paved roads	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dirt roads	0.00	1.18	0.69	0.00	1.82	1.25	0.78	1.61	1.84	1.18
Recent vehicle tracks	0.55	1.00	1.83	0.55	2.09	4.22	0.00	0.00	0.34	1.73
Old vehicle tracks	2.27	1.82	3.20	2.91	2.45	25.31	5.00	8.40	15.29	1.64
Motorcycle trails	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.23	1.15	0.00
Camp sites, fires	0.00	0.00	0.00	0.00	0.09	0.16	0.00	0.11	0.00	0.09
Fences	0.00	0.00	0.00	0.00	0.00	0.47	0.16	0.00	0.00	0.00
Mining	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	**2.18**
Sign of dogs	0.00	0.00	0.00	0.00	0.00	0.16	2.66	0.00	0.00	0.00
Survey markers, signs, posts, cairns	0.45	0.64	0.00	0.18	0.91	0.31	0.31	0.34	1.26	0.64
Other (see below)	OR			OR		U, W	V, W, H			D= 0.36
Total	11.09	55.91	8.70	13.82	47.9	81.57	143.60	16.43	27.50	22.64

Plot 1: 1 4-wheel drive road; close proximity to Hinkley; history of livestock grazing
Plot 2: 4.8 km of road on 3 boundaries
Plot 6: Human impacts are severe from grazing and vehicles; almost no shrubs are present. Vehicle use is high on open dirt roads and unauthorized cross-country routes; plot bordered on W by active agricultural field and ranch; old cattle watering site on plot. This is not an appropriate site to translocate tortoises.
Plot 7: Dirt roads bound 2.5 sides of the section, as well as fence on E side. One deep, unfenced hole on W boundary. Wilderness to the N. E edge of plot is adjacent to private property with agricultural fields, buildings, and dog kennels with >100 dogs. Six old cattle trails on plot; pulled up Wilderness sign.
Plot 8: pinflags, possible associated with rare plants, along N boundary.
Plot 9: Substantial evidence (craters and pits) of current and historic placer mining for gold; abandoned structures and grave N of plot. Most of plot consists of hills with rocky soils, which are light to moderately impacted by cross-country motorcycle use. People observed using the area for mining and OHV activities during survey and at other times.
Plot 10: One area denuded by vehicles, and three other denuded areas; significant general garbage near old mine excavation off plot, E edge, including old trucks, 21 tires, denuded areas.

OR = ordnance	V = vandalism
U = utility corridor	H = hazards, such as unfenced mining shafts
W = boundary with wilderness, or within wilderness	D = denuded, vehicles B = berms

Table 5. A summary of anthropogenic impacts recorded on transects from 45 one-square mile plots in the Western Expansion Translocation Area, in 2009. All sign counts have been converted to sign per kilometer of transect.

Types of anthropogenic impacts	Number of impacts/km of plot by plot identification number									
	12	13	14	16	17	18	19	20	21	22
Cattle scat, bones	0.82	0.34	0.27	0.00	0.00	0.34	0.11	1.49	0.23	0.00
General garbage	2.82	2.18	3.55	4.25	2.99	10.11	4.83	1.84	1.15	1.03
Balloons	0.73	0.57	1.09	0.23	0.46	0.69	0.46	0.69	1.15	0.46
Firearm casings/targets	0.36	0.23	3.55	0.80	0.34	0.34	1.03	0.69	0.00	1.03
People or footprints	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paved roads	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dirt roads	0.55	1.03	0.73	1.61	0.91	2.53	0.80	0.34	0.46	0.57
Recent vehicle tracks	1.09	3.33	1.55	0.46	0.00	0.34	1.26	0.46	0.34	0.46
Old vehicle tracks	1.73	7.7	7.91	12.64	14.71	3.22	6.89	14.25	14.71	8.28
Motorcycle trails	0.00	0.11	0.00	0.46	0.80	0.34	0.46	0.34	0.11	0.46
Camp sites, fires	0.00	0.00	0.18	0.11	0.00	0.11	0.11	0.00	0.00	0.00
Fences	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mining	0.00	0.00	0.00	0.80	0.11	0.92	0.22	0.00	0.00	0.00
Signs of dogs	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Survey markers, signs, posts, benchmarks	0.27	0.57	0.36	0.46	0.34	0.23	0.00	0.69	0.23	0.00
Other (see below)	OR		OR	D, H,		B=0.11	S			
Total	8.37	16.06	19.28	21.82	20.66	19.28	16.17	20.79	18.38	12.29

Plot 14: ~1.3 km of 4-strand barbed wire fence parallel and inside E boundary of plot; one dirt road cuts completely through the plot and another partially cuts through the plot.
Plot 16: Human impacts are high: several roads through the plot, unauthorized cross-country motorcycle use, several mining sites and an unfenced vertical shaft, denuded areas, and one shack. Abandoned shack S of plot.
Plot 17: High-bermed and high speed Copper City Road crosses north end of plot; scrapes, old encampment outside and adjacent to north boundary; mining claims; old cross-country motorcycle tracks.
Plot 18: Old cattle watering site N of N boundary, abandoned structure several hundred meters NW of N plot corner; inhabited residence ~500 m W; moderate impacts due to small-scale mines with associated roads and trash. Abandoned dirt road and berm are present.
Plot 19: Collapsed shack with large amount of trash (in addition to tally); also 40 m E is 2 x 2 x 5 m deep shaft fenced on 3 sides; additional associated trash. Plot currently is used as camp and shooting area. A cross-country motorcycle trail following an illegal route, marked by orange flagging is present also.
Plot 22: Closed road with vehicle tracks; 4 motorcycle trails.

OR = ordnance	D = denuded
B = Berms	H = hazards, such as unfenced mining shafts
S = structures	

Table 5, continued. A summary of anthropogenic impacts recorded on transects from 45 one-square mile plots in the Western Expansion Translocation Area, in 2009. All sign counts have been converted to sign per kilometer of transect.

Types of anthropogenic impacts	Number of impacts/km of plot by plot identification number								
	23	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**32**	**33**
Cattle scat or bones	0.00	0.00	0.11	0.00	0.00	0.41	0.34	0.00	0.00	0.00
General garbage	1.82	1.49	5.63	8.74	0.11	0.14	2.87	1.95	3.33	2.29
Balloons	1.64	0.23	0.34	0.69	0.46	0.41	0.34	0.92	0.11	0.57
Firearm casings/targets	0.82	1.49	1.38	6.09	0.57	0.41	0.57	0.69	0.23	0.69
People or footprints	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.00	0.00
Paved roads	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dirt roads	0.00	0.69	1.03	1.84	0.46	0.00	0.46	1.38	0.23	0.69
Recent vehicle tracks	0.00	0.80	1.26	0.69	1.15	2.05	4.71	0.46	0.11	0.00
Old vehicle tracks	3.09	11.38	13.22	8.39	1.61	10.96	15.98	14.02	2.41	5.86
Motorcycle trails	0.00	0.34	0.34	0.00	0.00	0.00	0.00	0.23	0.11	0.34
Camp sites, fires	0.00	0.34	0.57	0.23	0.11	0.00	0.00	0.00	0.00	0.11
Fences	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mining	0.00	0.34	0.46	0.23	0.00	0.00	0.00	0.46	0.23	1.03
Signs of dogs	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00
Survey markers, signs, posts	0.00	1.72	0.09	0.46	0.00	0.14	0.00	0.46	0.23	0.69
Other (see legend below)	OR		S= 0.23	Cu= 0.34			V= 0.11	D= 0.80; Car; H		aban. road = 0.34
Total	7.37	18.82	24.66	27.70	5.04	14.52	25.38	21.37	6.99	12.61

Plot 24: Extensive mining activity in central part of plot: many 2-3 m trenches, craters, 2 vertical shafts, small scraped tailing piles; moderate level of cross-country motorcycle travel, several minor roads.
Plot 25: High level of human impacts-Copper City road with high berm runs through plot; also several dirt roads cross the plot; significant cross-country motorcycle use; 4 long-term camps and shooting areas, some associated with small-scale mining; debris fields and 2 collapsed structures.
Plot 26: Springs (not on topographic map), weather station, trash associated with hunters and upslope mining. Unlike other plots, all firearm casings are shotgun shells; Native American stone rings (?).
Plot 27: Heavy vehicle use on and off road, concentrations in N and W part of plot where steep hill and washes occur.
Plot 28: Most of plot is too rugged to access easily; all motorcycle tracks in largest wash.
Plot 29: Habitat includes volcanic field in Black Mountain Wilderness and semi-badland topography. Vehicle tracks primarily associated with washes; some cross-country travel too; upland game guzzler on plot; vandalism = "closed" sign hidden in shrub.
Plot 30: BLM road stake at 500588E, 3893109N (Open route 7292) is placed in area with tracks or no roads (7292 is an actual road across the plot). One ORV camp with firewood and shooting use is N of transect; apparent stolen car with belongings abandoned at 501574E, 3893471N, CA license 1LJA319. Sandy pit used at motorcycle play area. Hazard: well casing that is extremely deep.
Plot 32: Closed dirt road with motorcycle tracks (2 observations, different transects).

OR = ordnance	D = denuded
B = Berms	H = hazards, such as unfenced mining shafts
S = structures	Cu = cultural resources

Table 5, continued. A summary of anthropogenic impacts recorded on transects from 45 one-square mile plots in the Western Expansion Translocation Area, in 2009. All sign counts have been converted to sign per kilometer of transect.

Types of anthropogenic impacts	Number of impacts/km of plot by plot identification number									
	34	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**44**	**45**
Cattle scat	0.92	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
General garbage	1.15	0.46	3.28	0.46	0.00	0.34	0.78	1.49	1.03	0.57
Balloons	0.34	0.46	0.63	0.11	0.34	0.11	0.47	0.69	0.34	0.23
Firearm casings/targets	0.57	0.57	1.25	0.57	0.68	0.92	1.09	0.34	2.07	0.57
People or footprints	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.00
Paved roads	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00
Dirt roads	0.00	0.00	0.63	0.34	0.00	0.11	0.31	0.92	0.23	0.00
Recent vehicle tracks	0.00	1.15	0.47	0.34	1.03	0.57	0.00	2.41	0.00	0.23
Old vehicle tracks	5.17	8.39	1.72	0.11	0.00	2.18	0.00	28.05	1.61	0.11
Motorcycle trails	0.00	0.23	0.0	0.00	0.46	0.00	0.00	1.95	0.00	0.00
Evidence of fire/camp sites	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Fences	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mining	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Signs of domestic dogs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Survey markers, signs, posts	0.34	0.34	0.47	0.00	0.00	0.00	0.16	0.23	0.57	0.00
Other (see legend below)		Cu	V= 0.16					V = 0.57		
Total	8.49	11.71	8.61	2.04	2.51	4.23	2.81	37.22	5.85	1.71

Plot 36: 2 pulled up "Open Route" signs 20 m from a road, under a shrub, 490475E, 3896784N
Plot 38: 16 vehicle tires in 3 groups of 10, 3, and 3 have been bolted together and dragged to SE corner of plot, just off transect line.
Plot 41: Shrine consisting of upright motorcycle with other ORV parts scattered about; ~40 plaques commemorating deceased ORV racers, including American flag (471104E, 3897032N); 4 groups totaling 16 people visited the shrine. Vandalism: 4 red fiberglass stakes and one T-post used to designate "closed" vehicle routes had been pulled and stashed under a creosote at 471222E 3897024N.
Plot 44: Evidence of burn in SE edge of plot.

Cu = Cultural artifacts	V = vandalism

Table 5, continued. A summary of anthropogenic impacts recorded on transects from 45 one-square mile plots in the Western Expansion Translocation Area, in 2009. All sign counts have been converted to sign per kilometer of transect.

Types of anthropogenic Impacts	**No. of impacts/km of plot by plot identification number**				
	47	**61**	**62**	**63**	**64**
Cattle scat	0.00	8.85	6.21	1.41	1.15
General garbage	38.49	0.57	1.72	3.59	0.92
Balloons	1.69	0.46	0.23	0.63	0.57
Firearm casings/targets	2.26	1.61	3.22	0.63	0.92
People or footprints	0.00	0.00	0.00	0.00	0.00
Paved roads	0.00	0.00	0.00	0.00	0.00
Dirt roads	0.94	0.57	1.38	0.63	0.34
Recent vehicle tracks	0.38	0.00	0.46	0.00	0.92
Old vehicle tracks	5.85	2.41	1.03	0.63	2.76
Motorcycle trails	0.00	0.00	0.00	0.00	0.00
Evidence of fire/camp sites	0.00	0.00	0.00	0.00	0.00
Fences	0.00	0.23	0.11	0.00	0.00
Mining pits, excavation	0.00	0.00	0.46	0.16	0.46
Signs of domestic dogs	0.00	0.00	0.00	0.00	0.00
Survey markers, signs, posts	0.38	0.00	0.57	0.00	0.00
Other			Cu= 2 sites	OR	0.57 burro scat
Total	49.99	14.70	15.39	7.68	8.61

Plot 47: Old habitation site at NE corner with substantial trash. Substantial trash also associated with roads. Occupied residence about 500 m to the N of plot. Two large trash sites with > 50 pieces each.
Plot 63: possible unexploded ordnance at UTMs 466526E, 3913125N; boundary fence of NAWS is parallel to and almost adjacent to north edge of plot.
Plot 64. boundary fence of NAWS parallels northern plot boundary; walked 10 m south of fence to avoid under-representation of garbage and impacts associated with fence.

Cu = cultural artifacts OR = ordnance

Table 6. A summary of tortoise sign found on 47 plots with complete coverage during 2009. Total sign includes live tortoises and all other sign.

Plot #	Transect distance (km)	Total sign/km	Live tortoises/ km	Number of tortoises and tortoise sign					
				Live	Dead	Active burrows	Inactive burrows	Scats	Other
1	263.6	2.84	0.046	12	60	20	126	513	18
2	255.0	3.13	0.051	13	30	29	231	494	12
3	228.3	2.92	0.092	21	78	61	151	349	6
4	260.9	2.62	0.073	19	62	32	271	289	11
5	251.2	0.87	0.012	3	23	14	71	106	1
6	185.6	0.07	0.000	0	5	0	5	3	0
7	189.4	0.03	0.000	0	2	0	0	4	0
8	259.2	0.12	0.004	1	21	1	7	1	0
9	252.3	1.37	0.039	10	77	18	109	132	0
10	253.6	1.98	0.032	8	82	48	125	238	4
12	135.6	7.30	0.155	21	35	97	267	555	15
13	268.8	0.18	0.004	1	34	0	13	0	0
14	259.2	0.79	0.008	2	59	8	53	83	1
16	254.5	0.62	0.024	6	23	13	85	28	4
17	187.7	0.35	0.000	0	35	0	30	0	0
18	262.9	1.03	0.034	9	12	26	116	104	3
19	260.7	0.49	0.019	5	52	9	17	44	1
20	241.3	3.29	0.091	22	78	67	216	407	5
21	260.0	1.48	0.038	11	87	40	135	111	1
22	259.2	0.97	0.042	2	84	12	49	103	2
23	257.7	0.50	0.004	1	36	3	41	48	0
24	260.5	0.78	0.058	15	40	40	64	34	11
25	259.2	0.34	0.019	5	14	10	45	11	3
26	254.4	0.48	0.008	2	4	12	50	53	2
27	235.6	0.55	0.017	4	56	12	23	34	0
28	*242.4	0.43	0.000	0	72	0	12	20	0
29	235.6	0.34	0.000	0	44	0	11	22	2
30	259.0	0.04	0.000	0	5	0	4	1	0
32	256.0	0.53	0.027	7	30	13	25	60	1
33	259.2	0.23	0.008	2	19	1	18	21	0
34	261.8	0.38	0.008	2	18	5	69	5	0
35	259.9	0.17	0.000	0	30	1	10	3	0
36	252.0	1.09	0.059	15	51	30	84	89	6
37	258.6	0.19	0.008	2	6	4	28	9	1
38	251.2	0.24	0.008	2	20	8	14	16	1
39	251.2	0.79	0.039	10	9	20	80	79	1
40	260.2	0.35	0.027	7	15	18	33	15	4
41	258.3	0.02	0.000	0	1	0	4	0	0
42	260.5	0.23	0.008	2	6	4	42	2	3
44	259.2	0.30	0.012	3	13	10	45	5	3
45	260.9	0.22	0.015	4	10	9	24	7	3
46	257.0	0.34	0.027	7	15	22	31	12	0
47	78.10	0.55	0.013	1	0	6	6	30	0
61	257.7	0.03	0.000	0	0	0	9	0	0
62	259.2	0.32	0.01	5	2	11	60	6	0
63	260.00	0.85	0.019	5	1	22	144	49	1
64	233.5	0.59	0.000	0	1	3	134	1	0

* Total transect distance was estimated for plot 28 (using grand mean average of transect distances). High ridges, steep gullies, and dangerous slopes required that coverage in parts of the plot be completed by walking ridges and washes rather than standard transect lines.

Table 7. Size-age class summary live desert tortoises on 37 plots receiving complete coverage in 2009. Ten other plots (plots 6, 7, 17, 28, 29, 30, 35, 41, 61, 64) also received a complete coverage but did not have live tortoises. All tortoises in this table received health evaluations unless noted as unprocessed.

Plot no.	Tortoises with completed health evaluations					Unprocessed tortoises		
	Adult males	Sub adult males	Adult females	Sub adult females	Total	Immature or juvenile tortoises	Adults: size and sex unknown	Total no. tortoises/ plot
1	5		6		**11**		1	**12**
2	6	1	3		**10**		3	**13**
3	16		4		**20**		1	**21**
4	8	1	9	1	**19**			**19**
5	1		2		**3**			**3**
8					**0**	1 immature		**1**
9	5	1	2	1	**9**		1	**10**
10	3	1	3	1	**8**			**8**
12	10	1	7	2	**20**		1	**21**
13					**0**		1	**1**
14					**0**	1 immature	1	**2**
16	3		1	1	**5**		1	**6**
18	5		3		**8**		1	**9**
19	2	1	1	1	**5**			**5**
20	14		5	1	**20**		2	**22**
21	5		2	3	**10**		1	**11**
22			2		**2**			**2**
23	1				**1**			**1**
24	6	3	3	1	**13**		2	**15**
25	2		3		**5**			**5**
26			1		**1**	1 immature		**2**
27	2		1		**3**	1 immature		**4**
32	1		5	1	**7**			**7**
33	2				**2**			**2**
34	1				**1**		1	**2**
36	7	1	5		**13**	1 immature, 1 juvenile		**15**
37	1		1		**2**			**2**
38	2				**2**			**2**
39	4		4	1	**9**		1	**10**
40	3		3		**6**	1 immature		**7**
42	1		1		**2**			**2**
44	1	1		1	**3**			**3**
45	2		1		**3**	1 immature		**4**
46	3	1	2		**6**	1 immature		**7**
47	1				**1**			**1**
62	2	1	1	1	**5**			**5**
63	3		2		**5**			**5**

* Note: Health evaluation forms have been completed for these individuals unless specified as unprocessed

Table 8, Tortoises with suspect or positive ELISA tests for *Mycoplasma agassizii* or *M. testudineum* or both species of *Mycoplasma,* with notes on clinical signs of upper respiratory tract disease.

Plot no.	Tort ID	Age	Size (mm)	Sex	ELISA status	Clinical signs of upper respiratory tract disease
1	7321	Adult	272	M	*M. agassizii* **positive**	MILD: L nare 10% occluded; mild crusts on palpebrae and periocular area; mild discharge in fornix of both eyes; mild peeling of scales on upper palpebrae of both eyes
1	7323	Adult	219	M	*M. agassizii* **suspect**	MODERATE to SEVERE: R nare 10% occluded; moderate to severe edema and crusts on upper and lower palpebrae of both eyes; moderate to severe wet discharge on lower palpebrae, mild peeling of scales of upper periocular area
1	7324	Adult	255	F	*M. agassizii* **positive** *M. testudineum* **positive**	MODERATE to SEVERE: Dried exudate in nares (moderate to severe); R and L nares 20% and 80% occluded respectively; A small amount of cloudy white particulates flushed from nares during lavage; mild edema and crusts of palpebrae and periocular area; mild peeling of scales in periocular area of both eyes, R eye 10% closed; moderate mucus present on R globe; conjunctiva 10% exposed in both eyes
2	7283	Adult	299	M	*M. agassizii* **suspect**	MODERATE. Partial (moderate) occlusion of L nare (with dried dirt -no % given); mild to severe crusts on palpebrae and periocular area of both eyes; mild wet discharge from L eye; mild peeling of scales on upper periocular area of R eye; conjunctiva 5% exposed in R eye
2	7284	Adult	262	F	*M. agassizii* **positive**	MILD to MODERATE: Mild to moderate edema (mostly of L eye); mild discharge at fornix of R eye; mild peeling of scales on lower periocular area of both eyes; R eye 40% closed; L eye 35% closed;
2	7285	Adult	288	M	*M. agassizii* **suspect**	MODERATE: Mild occlusion of L nare (10%- with dirt); moderate to severe crusts on palpebrae of both eyes; moderate dry discharge from R eye; mild peeling of scales on lower periocular area of L eye; R eye 50% closed; L eye 25% closed and covered with dirt (conjunctiva condition unclear)
3	7243	Adult	304	M	*M. agassizii* **suspect**	MILD to MODERATE: Mild discoloration of palpebrae of both eyes; mild edema in palpebrae and periocular area of both eyes; mild to moderate crusts of palpebrae and periocular area in both eyes; mild wet discharge from L eye, mild to moderate peeling of scales in palpebrae and periocular area of both eyes; conjunctiva 5% exposed in both eyes
3	7252	Adult	260	M	*M. agassizii* **positive**	MILD: Mild dried, yellow exudate in both nares; mild edema of periocular area of both eyes; mild to moderate crusts on palpebrae and periocular area of both eyes; mild peeling of scales in periocular area of both eyes; conjunctiva 5% exposed in both eyes
3	7253	Adult	243	M	*M. agassizii* **positive**	MODERATE to SEVERE: R and L nares 60% and 10% occluded, respectively; mild edema of palpebrae of both eyes; mild to moderate crusts on palpebrae and periocular area of both eyes; mild wet discharge from L eye, mild peeling of scales on palpebrae and periocular area of both eyes; R eyes mildly swollen; conjunctiva 5% exposed in L eye
4	7271	Adult	265	M	*M. agassizii* **suspect**	MILD: R and L nares both 5% occluded; mild discoloration of lower palpebrae of both eyes and upper palpebrae of L eye; mild edema of periocular area of both eyes; mild to moderate crusts in both eyes; mild wet discharge at fornix of both eyes; mild peeling of scales on periocular area of both eyes; R eye 50% closed

Table 8, continued. Tortoises with suspect or positive ELISA tests for *Mycoplasma agassizii* or *M. testudineum* or both species of *Mycoplasma,* with notes on clinical signs of upper respiratory tract disease.

Plot no.	**Tort ID**	**Age**	**Size (mm)**	**Sex**	**ELISA status**	**Clinical signs of upper respiratory tract disease**
4	7273	Adult	250	M	*M. agassizii* **positive**	MILD: R and L nares both 5% occluded; mild discoloration of upper palpebrae of L eye; mild edema of L eye; mild to moderate crusts in both eyes; mild wet discharge in fornix of L eye; mild peeling of scales on lower periocular area of both eyes; R and L eyes both 5% closed; conjunctiva 5% exposed in L eye (R not visible)
4	7311	Adult	274	M	*M. agassizii* **suspect**	MILD: mild peeling of scales in periocular area of L eye; R eye 40% closed; L eye 40% closed; conjunctiva 2% exposed in R eye and 5% exposed in L eye
4	7312	Adult	250	F	*M. agassizii* **positive**	MODERATE: Mild wet exudate dripping from R nare; mild clear wet exudate on beak; glaze of exudate partially occluding both nares; mild discoloration of upper and lower palpebrae of both eyes; mild to moderate edema (upper periocular area) and crusts on lower palpebrae of both eyes; mild dried discharge at fornix of R eye; mild peeling of scales in periocular area of both eyes; R eye 15% closed; L eye 20% closed; moderate dried and wet mucus present on R globe; conjunctiva 10% exposed in R eye
4	7313	Adult	238	F	*M. agassizii* **positive**	MILD: L nare 10% occluded; mild edema on upper palpebrae of both eyes; mild to moderate crusts on palpebrae of both eyes; mild amount of peeling scales at fornix of L eye
21	7206	Adult	240	M	*M. agassizii* **positive**	MILD: R nare 50% occluded (by dirt); mild edema of upper palpebrae of R eye; crusts of palpebrae and periocular areas in L eye; mild peeling of scales on palpebrae and periocular areas of both eyes; conjunctiva 5% exposed in both eyes
21	7207	Adult	276	M	*M. agassizii* **positive**	MILD: R and L nares 10% and 30% occluded respectively; mild edema and crusts of palpebrae and periocular area of both eyes; mild peeling of scales in periocular area of both eyes
32	7192	Adult	204	F	*M. agassizii* **positive**	MILD: R and L nares 10% and 5% occluded respectively; mild edema of upper palpebrae of both eyes; mild crusts on lower palpebrae of both eyes
39	7126	Adult	265	M	*M. agassizii* **positive**	MILD: mild edema of lower palpebrae and mild to moderate edema of lower periocular area of both eyes; mild crusts of palpebrae and periocular areas in both eyes; mild peeling of scales on palpebrae and periocular area of both eyes; both eyes partially closed (30%R, 20% L); conjunctiva 5% exposed in R eye, 10% in L eye
39	7143	Adult	253	F	*M. agassizii* **suspect**	MILD: R and L nares 10% and 15% occluded, respectively; mild edema and crusts of upper palpebrae of both eyes; mild dried discharge of both eyes; mucus present on globe of R eye
40	7124	Adult	210	F	*M. agassizii* **positive**	MODERATE to SEVERE: R nare 10%; mild discoloration of R eye and periocular area; mild to severe edema of palpebrae and periocular area of both eyes; mild to moderate crusts on palpebrae and periocular areas of both eyes; mild to moderate wet discharge from L eye, mild peeling of scales on periocular area of both eyes; R eyes partially closed (5%); mucus present on globe of both eyes; conjunctiva 5% exposed in R eye
63	7091	Adult	209	M	*M. agassizii* **suspect**	MILD to MODERATE: partial occlusion of the R nare (20%) and L nare (5%). Mild to moderate discoloration and edema of palpebrae of both eyes; mild crusts on palpebrae and moderate crusts on periocular areas of both eyes; moderate discharge at fornix of both eyes, also mucus. Eyes 25% closed; mild lateral swelling of eyes, and mild peeling of scales on R upper periocular area.

Table 9. Tortoises with **negative** ELISA tests for *Mycoplasma agassizii* and *M. testudineum,* but which exhibit multiple clinical signs of upper respiratory tract disease.

Plot no.	Tort ID	Age	Size (mm)	Sex	ELISA status	Clinical signs of upper respiratory tract disease
1	7318	Adult	252	F	negative	MODERATE to SEVERE: Nares occluded (90%R:50%L); both nares wet (moderate to severe); mild to severe edema of palpebrae of both eyes and mild edema of upper periocular area of L eye; mild to moderate crusts on palpebrae and periocular area of both eyes; mild wet discharge from both eyes; mucus present on globe of both eyes
1	7324	Adult	255	F	negative	MODERATE to SEVERE: Nares occluded (20%R:80%L); both nares damp (moderate to severe); mild to severe edema of palpebrae of both eyes and mild edema of upper periocular of L eye; mild to moderate crusts on palpebrae and periocular area of both eyes; mild wet discharge from both eyes; mucus present on globe of both eyes
1	7325	Adult	247	F	negative	MODERATE: L nare is 20% occluded and has moderate amount of dried exudate; mild edema of R eye upper palpebrae and periocular area and mild edema of L eye upper palpebrae; mild to moderate crusts on palpebrae and periocular area of both eyes; mild discharge from both eyes; L eye has mild peeling scales overall; eyes partially closed (50%R, 20%L); both eyes are dull and cloudy with a filmy covering; conjunctiva 2% exposed in L eye
4	7279	Adult	214	M	negative	MODERATE: Nares occluded (10%R:5%L); mild edema of palpebrae of both eyes and mild to severe crusts on palpebrae and periocular area of both; R eye severely swollen and partially closed with moderate wet discharge; conjunctiva exposed 40% in R eye and 10% in L eye
4	7310	Adult	245	F	negative	MODERATE: Nares occluded (10%R:30%L); mild crusts on lower palpebrae of R eye and mild to severe crusts on palpebrae and periocular area of L eye; R eye has moderate peeling scales overall and L eye has mild peeling scales on lower palpebrae
16	7136	Adult	290	M	negative	MODERATE to SEVERE: L nare 75% occluded; mild to moderate edema of palpebrae and periocular area of both eyes; mild crusts on palpebrae and moderate to severe crusts on periocular area of both eyes; mild wet discharge from both eyes, mild peeling of scales of upper periocular area on both eyes; conjunctiva 5% exposed in both eyes
45	7098	Adult	316	M	negative	MODERATE: Mild to severe edema and crusts on palpebrae and periocular area of both eyes; mild to moderate discharge from fornix of both eyes; L eye is moderately sunken; eyes partially closed (10%R:70%L); conjunctiva 5% exposed in R eye and L eye is obscured by crusts
46	7099	Adult	255	M	negative	MODERATE: L nare 20% occluded; mild to moderate edema and crusts of palpebrae and perioculars of both eyes; mild dry discharge from both eyes, mild peeling of scales of periocular area on both eyes; R eye mildly swollen; both eyes 20% closed and have mucus present on globes; conjunctiva exposed in both eyes (40%R:10%L)
63	7072	Adult	244	M	negative	MODERATE: Mild to moderate edema of palpebrae and periocular area of both eyes; mild to severe crusts on palpebrae and periocular area of both eyes; mild to moderate discharge from both eyes; R eye is moderately sunken; both eyes 20% closed; mucus present on globes of both eyes; R eye cloudy
63	7073	Adult	210	F	negative	MODERATE: R nare 20% occluded; mild edema of palpebrae and periocular area of both eyes; moderate to severe crusts on palpebrae/periocular area of both eyes; mild dry discharge from both eyes, mild peeling of scales of upper periocular area on both eyes; conjunctiva 20% exposed in both eyes

Table 10. Tortoises with signs of severe trauma from predators.

Plot no.	Tort ID	Age	Size (mm)	Sex	Trauma rating on gular horn			Signs of severe trauma
					Distribution	Severity	Chronicity	
1	7315	Adult	227	F	severe	moderate	Injuries healed or healing	Predator trauma to 25% of plastron including gular (100%); ≥ 9 marginal scutes have chips
1	7318	Adult	252	F	severe	severe	Injuries healed or healing	Most of gular chewed off
2	7283	Adult	299	M	severe	severe	Injuries healed or healing	Severe trauma from predator to entire gular, bone/scute replacement underway ≥ 5 marginal scutes
2	7284	Adult	262	F	severe	severe	Injuries healed or healing	Entire gular chewed off, 25% of humeral scutes chewed; ≥ 4 marginal scutes have chips
2	7285	Adult	288	M	severe	severe	Injuries healed or healing	Entire gular chewed off, ≥ 3 marginal scutes have chips
2	7286	Adult	305	M	severe	severe	Injuries healed or healing	Entire gular chewed off, ≥4 marginal scutes have chips
2	7317	Adult	284	M	moderate	severe	Injuries healed or healing	Trauma from predator on 90% of gular (bone/ scute replacement), carapace and plastron have 4 patches of trauma, ≥ 9 marginal scutes have chips
3	7656	Adult	211	F	severe	severe	Injuries healed or healing	Extensive trauma from predator on entire gular horn, 30% of both humeral scutes, and ≥ 14 other locations on shell; tooth marks present
4	7311	Adult	274	M	severe	severe	Injuries healed or healing	Trauma from predator to gular horn (completely chewed off), to plastron including both humeral scutes and 4 other patches with damaged scutes, ≥ 8 marginal scutes with trauma from chewing
5	7296	Adult	287	M	severe	severe	Injuries healed or healing	Extensive trauma from predator on gular (it is missing) and humeral scutes (25% with bone/scute replacement); trauma to plastron includes claw/gnash marks and ~ 4 sites with chewing; ≥ 15 marginal scutes have damage from chewing; forelimbs and foot pads have missing scales from chewing
9	7240	Adult	238	F	moderate	severe	Injuries healed or healing	Tip of gular horn chewed away on R side, numerous other small chips in laminae that appear to be from chewing
12	7169	Adult	238	F	mild	severe	Injuries healed or healing	Tips of both gular horns broken or chewed off

Table 10, continued. Tortoises with signs of severe trauma from predators.

Plot no.	Tort ID	Age	Size (mm)	Sex	Trauma rating on gular horn			Signs of severe trauma
					Distrubution	Severity	Chronicity	
12	7225	Adult	237	F	severe	severe	Injuries healed or healing	Tips of both gular horns chewed off, chipping and trauma from chewing on ≥ 5 marginal scutes
12	7228	Adult	250	M	severe	moderate	Injuries healed or healing	Extensive trauma from predator on gular and humeral scutes, plastron, carapace and ≥13 marginal scutes, forelimbs and foot pads also appear to have missing scales.
16	7136	Adult	290	M	severe	severe	Injuries healed or healing	Entire gular chewed off; predator trauma to 11 marginal scutes; 5 patches of bone and scute replacement on carapace and on plastron (10 total)
16	7139	Young adult	192	F	moderate	moderate	Injuries healed or healing	Trauma from predator to L gular horn (edge missing); predator-caused chips and bone/scute replacement on 16 marginal scutes, 15 sites on carapace and 10 patches on plastron
16	7162	Adult	237	F	severe	severe	Injuries healed or healing	Predator trauma: 100% of gular consists of replaced scute and bone; gular is deformed and leading edges are missing; 13 marginal scutes have bone/scute replacement and 13 additional patchs are visible on plastron
18	7138	Adult	248	F	moderate	moderate	Injuries healed or healing	Predator trauma on entire gular (most is missing); 6 marginal scutes have chips; 25% of humeral scutes have damage from chewing and gnawing
18	7156	Adult	224	M	moderate	severe	Injuries healed or healing	Tips of both gular horns have been chewed off, 3 seams of marginal scutes have bone/scute replacement
19	7195	Young adult	198	M	severe	moderate	Injuries healed or healing	Extensive trauma to gular horn from predator
20	7194	Adult	258	M	moderate	severe	Injuries healed or healing	Gnawing marks on both sides of gular horn
20	7173	Adult	245	F	moderate	severe	Injuries healed or healing	Predator damage to entire gular horn, missing layers of laminae and tip missing
21	7205	Young adult	199	F	severe	severe	Injuries healed or healing	Severe trauma to tips of both gular horns from predator
22	7090	Adult	220	F	severe	severe	Injuries healed or healing	Predator trauma to 100% of gular horn, tips missing; bone/scute replacement underway on 25% of humeral scutes, 4 marginal scutes and 4 patches on carapace; plastron has 5 additional small chips or tooth marks

Table 10, continued. Tortoises with signs of severe trauma from predators.

Plot no.	Tort ID	Age	Size (mm)	Sex	Trauma rating on gular horn			Signs of severe trauma
					Distribution	Severity	Chronicity	
22	7176	Adult	220	F	moderate	moderate	Injuries healed or healing	Predator trauma to >25% of gular horn, 50% of L horn is missing; patches of bone/scute replacement are visible on 4 marginal scutes, 4 scutes of carapace and 2 sites on plastron
24	7056	Young adult	200	F	severe	severe	Injuries healed or healing	Predator trauma to 50% of gular horn, 14 marginal scutes have chips/bone scute replacement, 22 additional locations with chips or bone/scute replacement on carapace and plastron
24	7087	Adult	254	M	severe	severe	Injuries healed or healing	Predator trauma to 60% of gular horn and humeral scutes; 3 additional locations have chips, forelimbs have a few damaged scales
24	7131	Adult	219	F	severe	moderate	Injuries healed or healing	Predator trauma to 100% of gular horn, tips chewed off; chips and bone/scute replacement on 9 marginal scutes, 7 locations on plastron and carapace
25	7152	Adult	226	F	severe	severe	Injuries healed or healing	Predator trauma to 100% of gular horn and tip of L horn is missing; severely chewed areas covers 25% of humeral scutes and 12 marginal scutes
25	7153	Adult	256	M	severe	severe	Injuries healed or healing	Predator trauma to 50% of gular horn, tip of R horn chewed off; trauma to 6 marginal scutes from chewing; 3 sites on carapace, 4 patches of bone/ scute replacement on humeral and femoral scutes
26	7177	Adult	236	F	severe	severe	Injuries healed or healing	Predator trauma to 100% of gular horn (anterior edge also chewed off); trauma to 9 marginal scutes; humeral and femoral scutes, forelimbs and hind toe pads are missing scales
27	7163	Adult	297	M	severe	moderate	Injuries healed or healing	Predator trauma to gular horn (30% of R horn missing), chips/tooth marks and gnawing visible on 2 marginal scutes and 7 locations on plastron and carapace
32	7158	Adult	232	F	severe	severe	Injuries healed or healing	Predator trauma to 100% of gular horn (scarring from bone/scute replacement); trauma covers 25% of humeral scutes, 6 marginal scutes with bone/scute replacement

Table 10, continued. Tortoises with signs of severe trauma from predators.

Plot no.	Tort ID	Age	Size (mm)	Sex	Trauma rating on gular horn			Signs of severe trauma
					Distribution	Severity	Chronicity	
32	7191	Adult	213	F	severe	moderate	Injuries healed or healing	Predator trauma to 25% of gular horn, tip of L horn is missing; scales missing on forelimbs and exposed bone from chewing on L hind toe
32	7192	Young Adult	204	F	severe	moderate	Injuries healed or healing	Predator trauma to 40% of gular horn, chewing resulting in chips on 3 marginal scutes and 7 other small patches on carapace and plastron
37	7069	Adult	280	M	severe	mild	Injuries healed or healing	Predator trauma to 100% of gular horn, 5 marginal scutes with chips or bone/scute replacement
37	7078	Adult	230	M	severe	moderate	Injuries healed or healing	Predator trauma to all of gular horn, anterior edge appears chewed off; 7 sites with predator damage on plastron, marginal scutes from LM4 to RM2 have extensive trauma from chewing; ≥9 small chips/trauma on carapace, both forelimbs have missing scales due to trauma
39	7119	Adult	234	F	severe	severe	Injuries healed or healing	Predator trauma to gular horn (almost completely chewed off), damage extends into vertebral scute 1 and first costal scutes; 11 anterior and posterior marginal scutes severely chewed
39	7120	Adult	246	M	severe	moderate	Injuries healed or healing	Severe predator trauma to 50% of gular horn, L tip of horn missing; bone/scute replacement on humeral and posterior scutes of plastron; chips/chews to 10 marginal scutes, 4 small chips on carapace
39	7127	Adult	253	F	severe	severe	Injuries healed or healing	Predator damage to 100% of gular horn, L tip is missing, 5% of humeral scutes have bone/scute replacement, 11 chips and chew marks are visible on plastron and carapace
39	7129	Adult	260	F	severe	moderate	Injuries healed or healing	Predator damage to 70% of gular horn and R horn is missing tip, 5 sites of chewing visible on plastron, LM scutes 1-3 have extensive trauma from chewing
42	7077	Adult	270	M	severe	moderate	Injuries healed or healing	Left tip of gular partially chewed off, remaining gular damaged, humeral scutes have missing laminae (5%), parts of anal and femoral scutes are missing, 9 marginal scutes have been chewed, all limbs have some missing scales due to trauma

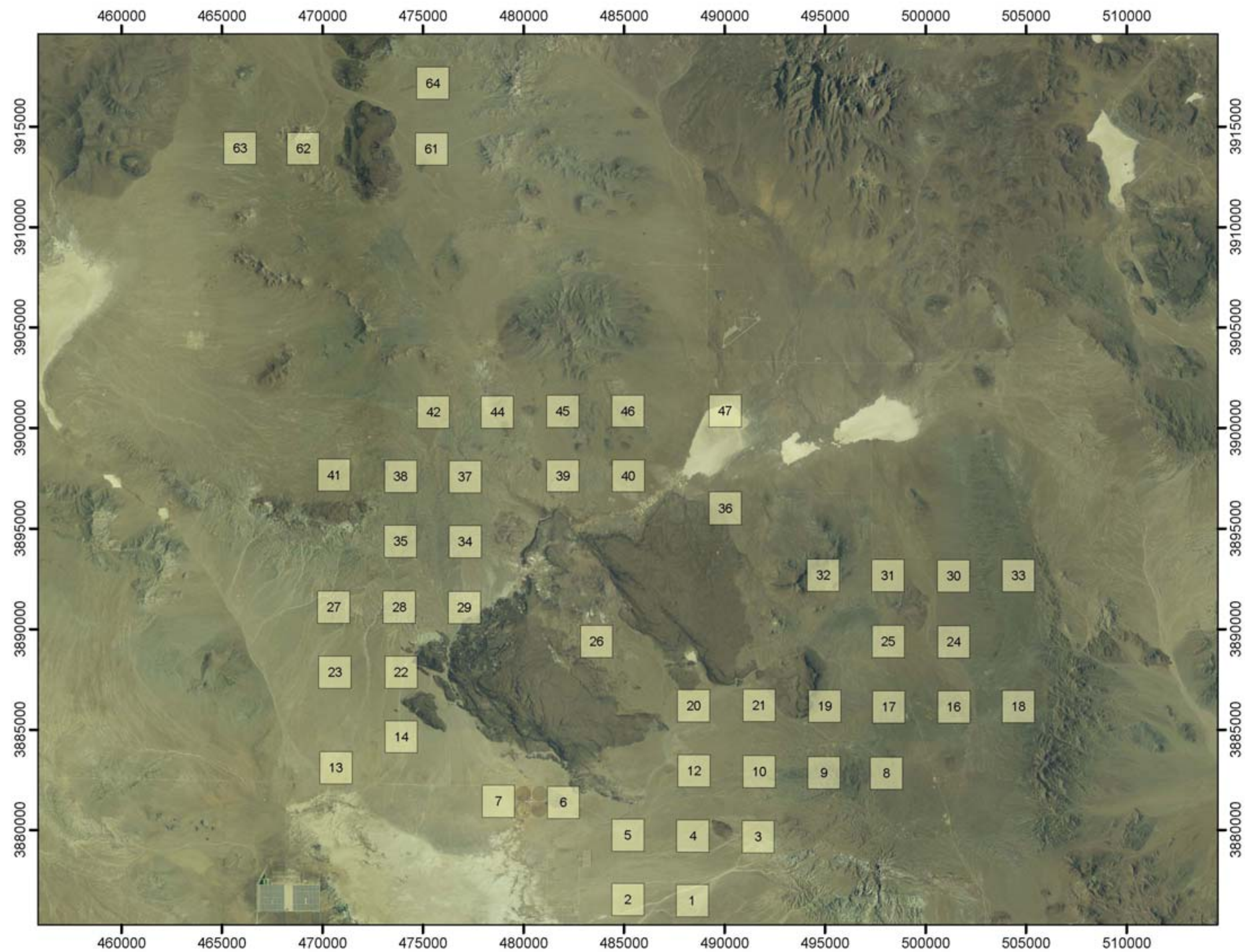

Figure 1. Location of 48 survey plots for 2009 in the Western Expansion Translocation Area (WETA) of Ft. Irwin.

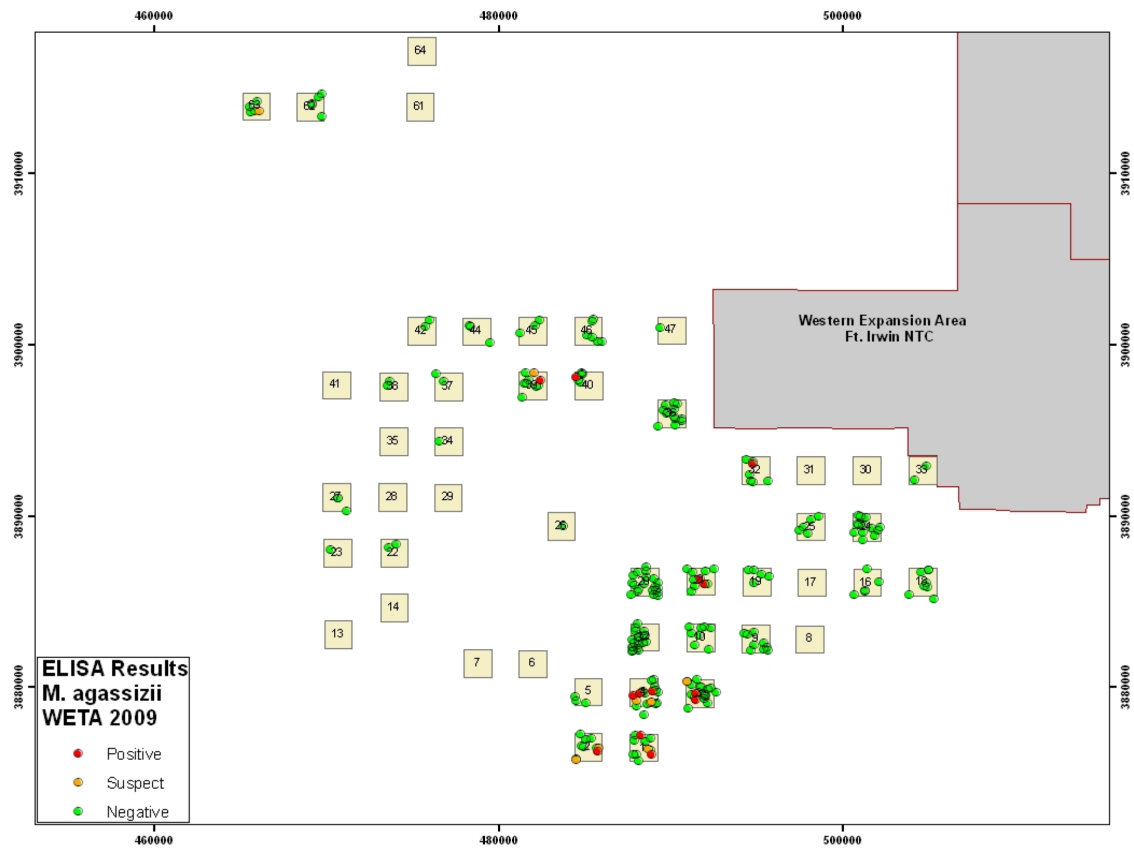

Figure 2. Distribution of 240 tortoises with negative, suspect, and positive ELISA tests for *Mycoplasma agassizii* in the Western Expansion Translocation Area.

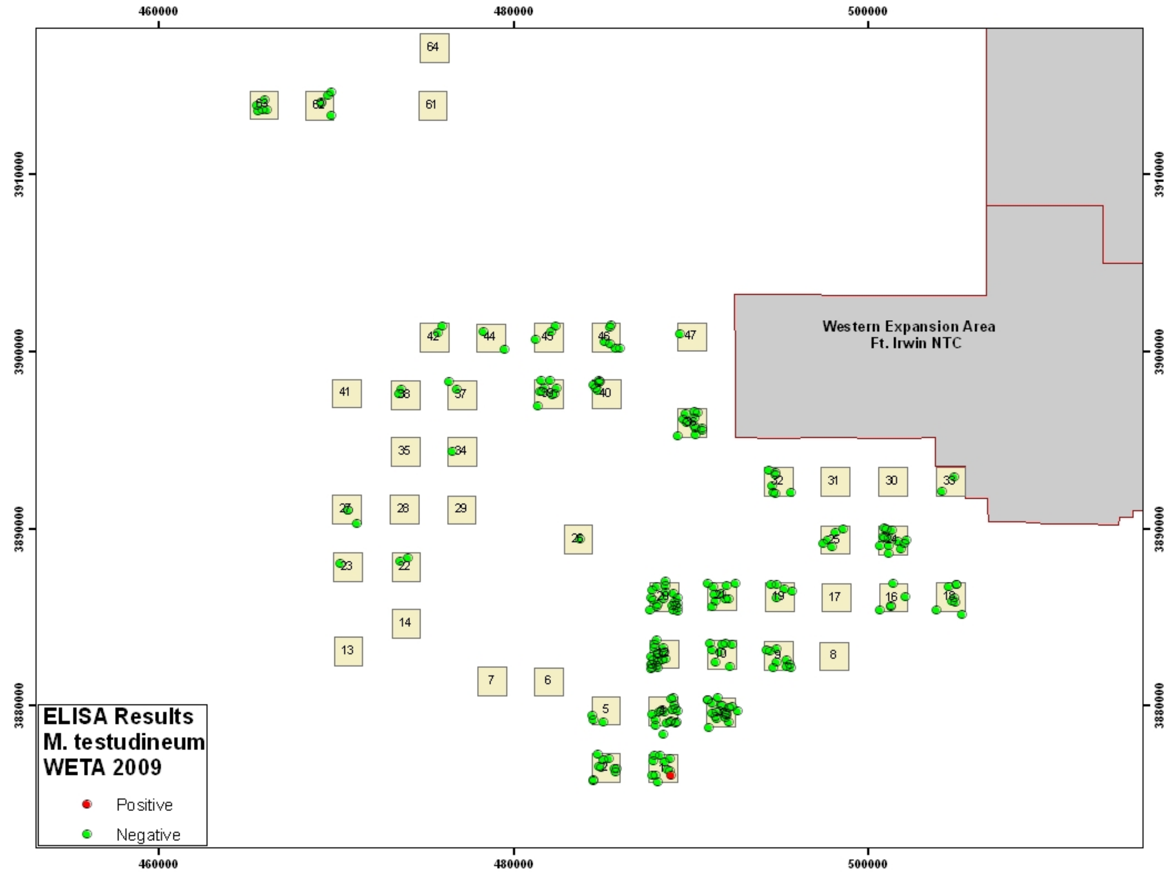

Figure 3. Distribution of 240 tortoises with negative and positive ELISA tests for *Mycoplasma testudineum* in the Western Expansion Translocation Area. No tortoises had suspect ELISA tests.

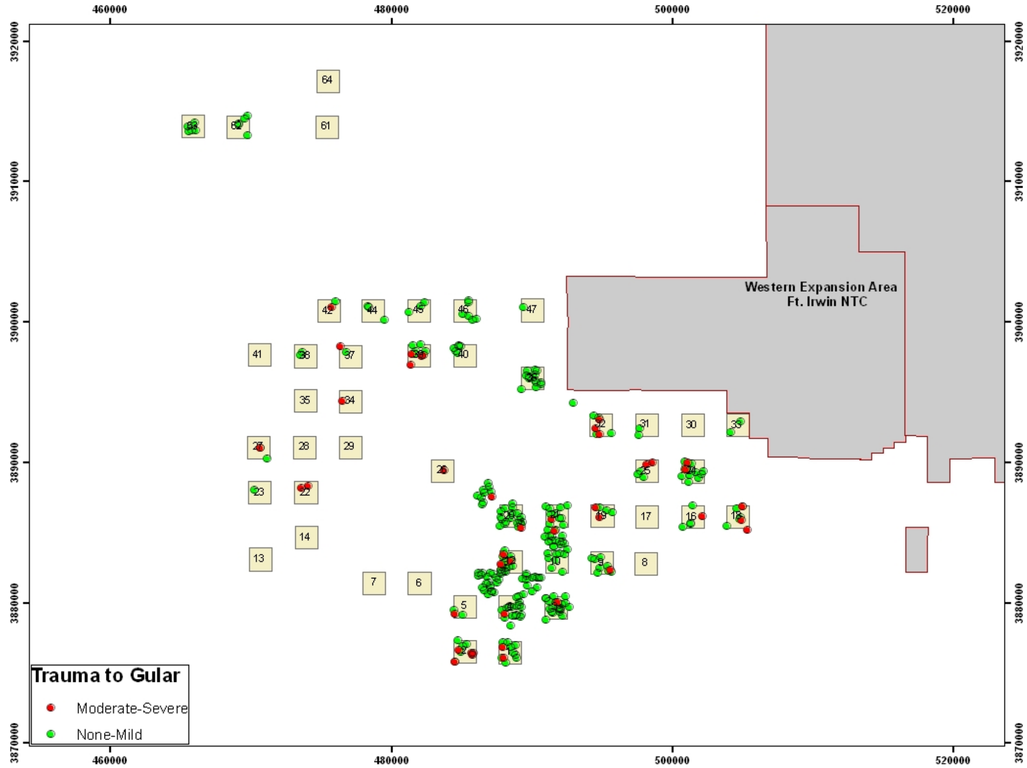

Figure 4. Locations of tortoises with evidence of severe trauma from predator attacks in the WEA and WETA.

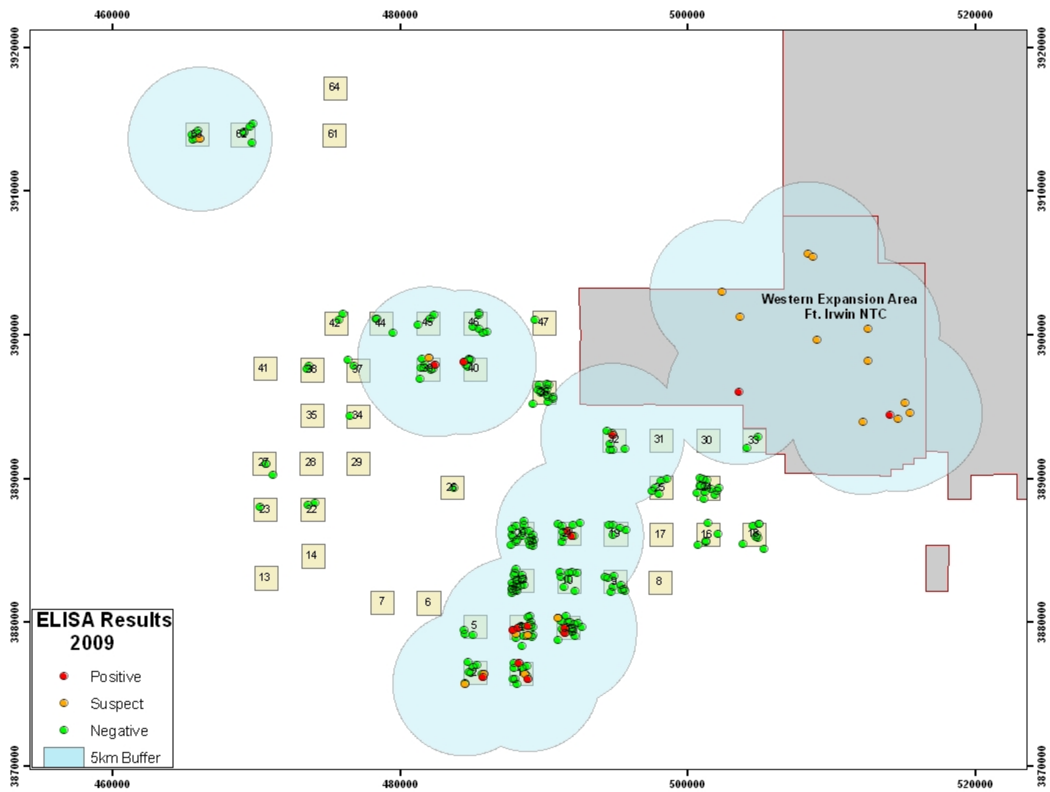

Figure 5. Locations of tortoises in the WEA and WETA in 2009 with a 5 km buffer (blue) drawn around individuals with suspect, and positive ELISA test results for *Mycoplasma agassizii* and *M. testudineum*.

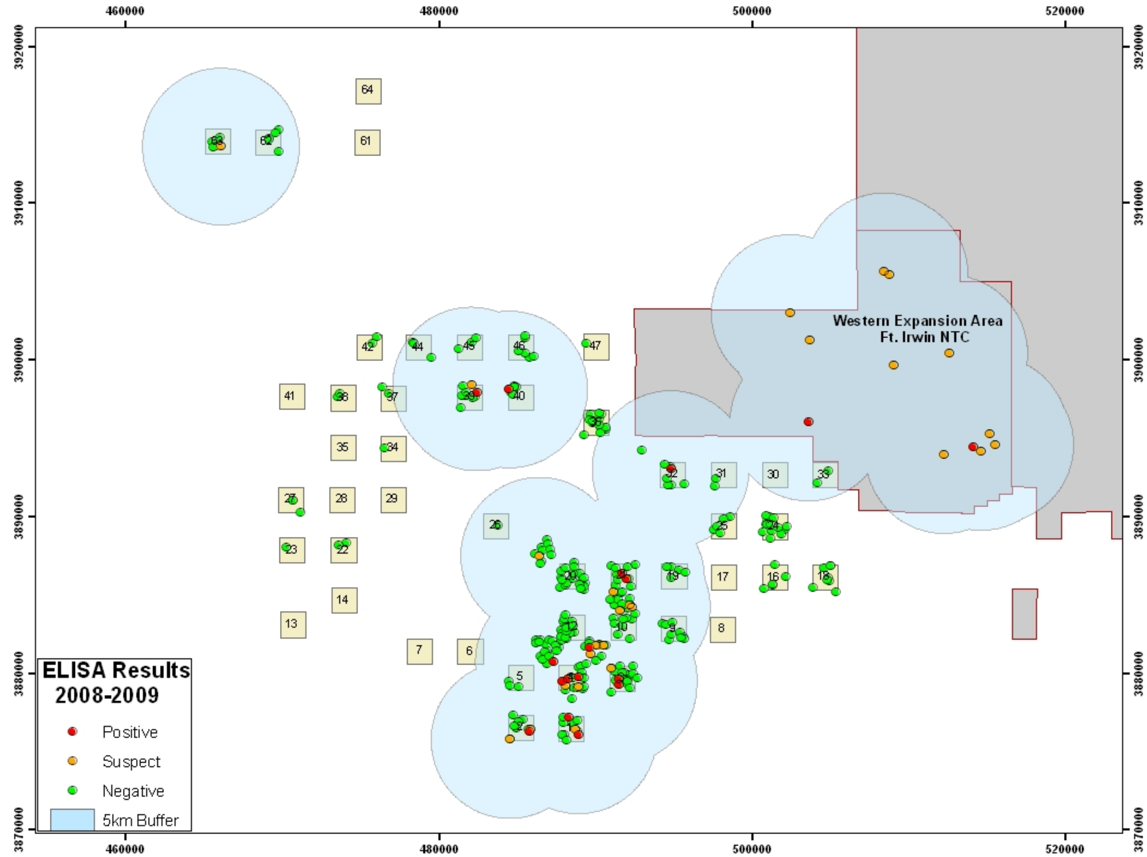

Figure 6. Locations of tortoises in the WEA and WETA in 2008 and 2009, with a 5 km buffer (blue) drawn around individuals with suspect and positive ELISA tests for *M. agassizii* and *M. testudineum*.

APPENDIX 1: Locations of 48 sample plots.

Plot no.	Township, Range, Section	UTMs ,Southwest corner	
		Easting	Northing
1	T11N, R2W, Sec. 19	487599	3875684
2	T11N, R3W, Sec. 23	484391	3875732
3	T11N, R2W, Sec. 9	490870	3878861
4	T11N, R2W, Sec. 7	487623	3878904
5	T11N, R3W, Sec. 11	484394	3878946
6	T11N, R3W, Sec. 4	481184	3880572
7	T11N, R3W, Sec. 6	477958	3880622
8	T12N, R1W, Sec. 31	497255	3882018
9	T12N, R2W, Sec. 35	494141	3882040
10	T12N, R2W, Sec. 33	490924	3882101
12	T12N, R2W, Sec. 31	487684	3882139
13	T12N, R4W, Sec. 32	469876	3882304
14	T32S, R44E, Sec. 32	473128	3883840
16	T32S,R47E, Sec. 30	500597	3885319
17	T32S, R46E, sec. 26	497366	3885324
18	T32S, R47E, Sec. 28	503815	3885342
19	T32S, R46E, Sec. 28	494181	3885368
20	T32S, R45E, Sec. 26	487661	3885381
21	T32S, R46E, Sec. 30	490927	3885395
22	T32S, R44E, Sec. 20	473115	3887058
23	T32S, R43E, Sec. 24	469825	3887054

24	T32S, R47E, Sec. 18	500594	3888565
25	T32S, R46E, Sec. 14	497338	3888578
26	T32S, R45E, Sec. 17	482834	3888594
27	T32S, R43E, Sec. 12	469762	3890289
28	T32S, R44E, Sec. 8	473023	3890288
29	T32S, R44E, Sec. 10	476257	3890282

APPENDIX 1 (Continued): Locations of 48 sample plots.

Plot no.	**Township, Range, Section, Meridian**	**UTMs ,Southwest corner**	
		Easting	Northing
30	T32S, R47E, Sec. 6	500593	3891853
31	T32S, R46E, Sec. 2	497330	3891866
32	T32S, R46E, Sec. 4	494106	3891886
33	T32S; R47E, Sec. 4	503815	3891859
34	T31S, R44E, Sec. 34	476296	3893547
35	T31S, R44E, Sec. 32	473088	3893576
36	T31S, R45E, Sec. 25	489235	3895197
37	T31S, R44E, Sec. 22	476298	3896761
38	T31S, R44E, Sec. 20	473092	3896769
39	T31S, R45E, Sec 19	481160	3896806
40	T31S, R45E, Sec. 21	484411	3896805
41	T31S, R43E, Sec. 24	469786	3896845
42	T31S, R44E, Sec. 9	474721	3899987
44	T31S, R44E, Sec. 11	477902	3899983
45	T31S, R45E, Sec. 7	481154	3900013
46	T31S, R45E, Sec. 9	484392	3900027
47	T31S, R45E, Sec. 12	489226	3900038
61	T29S, R44E, Sec. 33	474635	3913083
62	T29S, R43E, Sec. 35	468250	3913106
63	T29S, R43E, Sec. 33	465104	3913124
64	T29S, R44E, Sec. 21	474699	3916353

EXHIBIT 615

From:	Kristin H Berry
To:	Everly, Clarence A CIV USA IMCOM
cc:	Roy Averill-Murray; Becky Jones
Subject:	Dead and Missing tortoises, Health research project
Date:	04/29/2009 03:46 PM

Regarding the discussion at the meeting yesterday, and status of the Health Research Project, part of the Ft. Irwin Desert Tortoise Translocation Project:

I've spent much of today reviewing the April data sets for dead and missing tortoises and adding the material into the totals. We had quite a rise in losses between March and April. We started with 158 tortoises on Plots 1.5, 3, 5, and 8 in March/April 2008. The total dead and missing are now 52 tortoises (32.9%) and 27 tortoises (17.1%), respectively. Combined, the figure is 79 tortoises or 50% of the total. In April alone, 9 were found dead and 12 were newly missing. I surely hope we can find some of the missing alive. For Plot 3, 72.5% of the tortoises are dead or missing; for Plot 5, 65% of the tortoises are dead or missing. I have teams out there now looking for these tortoises.

I'll be asking Dr. Yee to work on the power analysis to determine if the original objectives can still be achieved with the remaining sample sizes.

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EXHIBIT 616

Points of View: A Controversy in Conservation Biology

Editor's Note.—The following three papers constitute an essay by C. K. Dodd, Jr. and R. A. Seigel followed by two replies to the essay by, respectively, R. L. Burke and H. K. Reinert.

Herpetologica, 47(3), 1991, 336–350

RELOCATION, REPATRIATION, AND TRANSLOCATION OF AMPHIBIANS AND REPTILES: ARE THEY CONSERVATION STRATEGIES THAT WORK?

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Abstract: Conservation strategies involving relocations, repatriations, and translocations (RRT) have been carried out, are underway, or are advocated for a number of endangered and threatened amphibians and reptiles. However, recent reviews of RRT projects involving birds and mammals suggest that the success rate is low and that the factors that lead to endangerment operate to impede effective RRT results. In this paper, we review available information on RRT projects involving amphibians and reptiles, examine the motives for advocating RRT strategies, and recommend biological and management criteria that should be considered prior to undertaking RRT projects. Most RRT projects involving amphibians and reptiles have not demonstrated success as conservation techniques and should not be advocated as if they are acceptable management and mitigation practices. We urge caution in accepting claims of success and urge colleagues to publish detailed methods and results of past and ongoing RRT projects.

Key words: Amphibians; Reptiles; Repatriation; Relocation; Translocation; Conservation; Management

The concept of re-establishing populations of endangered or threatened species in areas where they have been extirpated has become extremely popular in recent years. For example, Griffith et al. (1989) reported that approximately 700 translocations or repatriations occurred each year, mainly in the United States and Canada. Variously termed "reintroductions", "translocations", and "repatriations", such programs have the laudable goal of reducing the probability of extinction by increasing the number of viable populations or increasing the number of individuals in small populations (Campbell, 1980; Scott and Carpenter, 1987). Repatriations into natural habitats are frequently combined with captive-breeding programs at zoological parks (Scott and Carpenter, 1987) and may spark wide public interest.

Despite the increasing popularity of repatriation programs as a conservation technique, serious questions have arisen about the theory behind such programs and their effectiveness (British Herpetological Society, 1983; Campbell, 1980; Conant, 1988; Griffith et al., 1989; Mlot, 1989; Scott and Carpenter, 1987; Tasse, 1989). In a comprehensive review of the success of repatriation and translocation programs for birds and mammals, Griffith et al. (1989) found an overall project success rate f 44%. They noted that success rates were pparently dependent on a variety of ecological factors, including the quality of the habitat where the release occurred, whether the individuals released were wild or captive-bred, and the feeding habits of adults.

There has been considerable recent interest in the conservation of reptiles and mphibians despite the fact that they lack he broad public appeal of birds and mamnals. In the United States, Puerto Rico, and the U.S. Virgin Islands, 11 species of amphibians and 29 species of reptiles are currently on the federal list of Endangered and Threatened Wildlife and Plants, with many other species protected by state and territorial regulations. Frequently, management, conservation, and recovery plans or endangered or threatened reptiles and mphibians involve repatriation, relocaion, or translocation (hereafter referred to as RRT) programs. Such programs often become highly visible and intertwined with local political concerns. For example, relocation programs for the gopher tortoise (*Gopherus polyphemus*) have been used as mitigation allowing development of uplands habitats throughout Florida. Given he extremely limited resources (both in ime and money) available for conservation programs for reptiles and amphibians, a detailed understanding of the effectiveness of repatriations or translocations is essential (Scott and Carpenter, 1987). However, we are unaware of any critical review of the success of repatriation or translocation programs for amphibians and reptiles. In this paper, we provide such a reiew.

Definitions

A wide variety of terms have been used to refer to programs where animals are released into areas where they have become extirpated or rare (British Herpetological Society, 1983; Conant, 1988; Griffith et al., 1989; Mlot, 1989; Scott and Carpenter, 1987; Tasse, 1989). For the urposes of this paper, we define the rease of individuals of a species into an area ormally or currently occupied by that species as a repatriation, whereas releases of individuals into geographic areas not historically occupied by that species are termed translocations. Relocation involves moving an animal or population of animals away from an area where they are immediately threatened (e.g., by development) to an area where they would be less prone to habitat loss; ideally, relocated animals should be moved to habitats where they historically occurred, but this is not always the case.

There is considerable confusion in the literature concerning what the term "success" means in the context of repatriation or translocation programs. Because the goal of any conservation program is the establishment (or enhancement) of a viable, self-sustaining population, we follow Griffith et al. (1989) in defining a repatriation, relocation, or translocation as successful only if evidence is presented that a self-sustaining population has been established. Hence, the presence of some breeding individuals does not, in our opinion, constitute evidence for success unless it can be shown that the population is at least stable. Because many endangered reptiles and amphibians have long life spans (e.g., sea turtles, tortoises), determining the success of a given release may be difficult and time-consuming. Nonetheless, we suggest that the burden of proof is on the investigator to show that a self-sustaining population exists before declaring success; to do otherwise would be to imply that the probability for extinction has been lowered for that species, when, in fact, this may not be true.

Our review is based on published references in the open literature, unpublished references (often in the form of reports to various resource management agencies), and personal communications solicited from colleagues. We recognize that we may have missed RRT programs whose results remain unpublished.

Discussion of RRT Programs

We documented RRT programs that had been carried out for 25 species of amphibians and reptiles (Table 1). We consider the RRT programs for *Chelonia mydas* separately, but combine RRT programs

TABLE 1.—Tabulation of actual and planned RRT projects involving amphibians and reptiles. U = unknown, E = eggs, L = larvae, J = juveniles, H = hatchlings, A = adults, N = not successful, C = casual observations. Reasons for relocation failure as follows: 1 = unknown, 2 = unsuitable habitat, 3 = unsuitable developmental conditions, 4 = human predation, 5 = animals moved away from release site, 6 = mongoose predation, 7 = poor release design.

Species	Location	Stage	Success	Reproduction	Follow-up	Reference
RRT projects completed or in progress						
Amphibians						
Salamanders						
Plethodontidae						
Plethodon idahoensis	Montana	A?	U(2, 7)		U	Anon (1990)
Salamandridae						
Triturus vittatus	USSR	J	U	Y	Y	Goncharov et al. (1989)
Frogs						
Bufonidae						
Bufo calamita	England	L, U	N(1)		U	Beebee (1983); Corbett (1989)
Peltophryne lemur	Puerto Rico	J, A	U		C	Miller (1985); Paine and Duval (1985); Paine et al. (1989); Paine (personal communication)
Pelobatidae						
Pelobates syriacus	USSR	L, J	U	Y	Y	Goncharov et al. (1989)
Reptiles						
Turtles						
Cheloniidae						
Caretta caretta	Virginia	E	N(1, 3)	N	C	Dodd (1988*a*)
Chelonia mydas	Caribbean	H	N(1)	N	N	Carr (1984); Dodd (1982); Huff (1989); Parsons (1962)
	Florida	H	U	U	C	
Lepidochelys kempi	Texas	E	U	N	Y	Caillouet and Landry (1989)
Chelydridae						
Macroclemys temmincki	Georgia	H	U	U	U	Pritchard (1989)
Testudinidae						
Geochelone elephantopus	Galapagos Is.	J	U	Y	U	MacFarland et al. (1974); Bacon and Reynolds (1982); Snell (personal communication)
G. gigantea	Seychelles	A	U(4)	Y	Y	Stoddart et al. (1982); Samour et al. (1987); Spratt (1989)
Gopherus polyphemus	Southeast USA	A	U(1, 2, 4, 5)	Y	Y, N, U	Bard (1989); Burke (1987, 1989*a,b*); Diemer (1986, 1987, 1989); Dietlein and Smith (1979); Doonan (1986); FGFWFC (1989); Fucigna and Nickerson (1989); Godley (1989); Layne (1989); Lohoefener and Lohmeier (1986); Stout et al. (1989)
Xerobates agassizi	California	A	N(1, 5)		Y, C	Berry [illegible]; Cook (1983); Cook et al. (1978); St. Am[illegible] Hoover (1980); Web[illegible] (197[illegible]

						Stout et al. (1989)
Xerobates agassizi	California	A	N(1, 5)		Y, C	Berry (1986); Cook (1983); Cook et al. (1978); St. Amant and Hoover (1980); Weber et al. (1979)

Species	Location	Stage	Success	Reproduction	Follow-up	Reference
Lizards						
Cordylidae						
Cordylus giganteus	South Africa	U	U		U	Jacobsen et al. (1990)
Iguanidae						
Conolophus subcristatus	Galapagos Is.	U	U	Y	U	Snell (personal communication)
Cyclura pinguis	Br. Virgin Is.	U	U		U	Lazell (1989)
Lacertidae						
Lacerta agilis	England	A	Y, N, U(1, 2)	Y	Y	Corbett (1988); Spellerberg (1988); Spellerberg and House (1982)
Teiidae						
Ameiva polops	US Virgin Is.	A	N(6)	N	C	Dodd (1978)
Snakes						
Colubridae						
Drymarchon corais	Southeast US	A, J	U(1)		U	Smith (1987); Speake et al. (1987)
Crocodiles						
Crocodylidae						
Alligator mississippiensis	Arkansas	U	Y	Y	C?	Joanen and McNeese (1990)
Crocodylus niloticus	Nigeria	A	U		N	Morgan-Davies (1980)
C. palustris	India	J	Y		Y?	Choudhury and Bustard (1982)
C. porosus	India	H	Y		Y	Choudhury and Chowdhury (1986)
Gavialidae						
Gavialis gangeticus	India	J, H	Y	Y	Y	deVos (1984); Choudhury and Chowdhury (1986); Rao (1990)
Planned or proposed RRT projects						
Amphibians						
Plethodontidae						
Batrachoseps aridus	California					USFWS (1982)
Bufonidae						
Bufo hemiophrys	Wyoming					USFWS (1990*a*)
Discoglossidae						
Alytes muletensis	Mallorca					Tonge (personal communication)
Reptiles						
Scincidae						
Leiolopisma telfairi	Round Is.					Bloxam (1982); Tonge (personal communication)
Teiidae						
Cnemidophorus vanzoi	St. Lucia					Tonge (personal communication)

for other species. Of these RRT projects, five (19%) were classified as successful, six (23%) were unsuccessful, and 15 (58%) could not be classified although in six instances reproduction occurred. Thus, the success rate for RRT programs for reptiles and amphibians is considerably lower than for birds and mammals (44%: Griffith et al., 1989). Moreover, the success rate for reptiles and amphibians varied phylogenetically; of the five successful programs, four involved crocodilians. If projects were considered individually rather than by species, especially for all gopher tortoise RRT's, the success rate would be lowered considerably. Although reproduction may have occurred, no RRT program has yet established a self-sustaining population of snakes, turtles, frogs, or salamanders.

We recognize that some of the cases marked as "unknown" could eventually prove to be successful, such as projects involving the Aldabra and Galapagos tortoises and Galapagos land iguana. We also note that some of the cases currently listed as successful are based on limited follow-up data, and long-term studies could show that initial optimism was premature. There are few published accounts dealing with the rationale, methodology, results, and criteria for success of conservation-related repatriation, relocation, or translocation projects (but see Stubbs, 1989).

Examples of RRT Projects

In the following section, we summarize data on several representative RRT activities. While space limitations preclude a detailed summary of each actual or proposed RRT project listed in Table 1, a summary can be obtained by contacting the authors.

Bufo houstonensis.—Conservation efforts for the Houston toad have involved extensive data collection on both natural populations and the husbandry of toads in captivity. The project was begun in 1978 by the Houston Zoo to identify remaining populations and to either supplement existing populations or to start new populations in protected areas using wild adults, naturally deposited eggs, or captive-reared juveniles and adults. Ten sites at Attwater Prairie Chicken National Wildlife Refuge (APCNWR) were chosen in 1982 for [illegible] introduction, and tadpoles or juveniles [illegible] observed 6 wk after the 1982 and 1[illegible] releases. Detailed descriptions of husbandry, sites, release methods and numbers, and monitoring are contained in unpublished reports to the U.S. Fish and Wildlife Service (Quinn, 1980, 1981; Quinn and Ferguson, 1983; Quinn et al., 1984). However, despite careful laboratory and field techniques and the introduction of 0.5 million individuals since 1982 (adults, juveniles, recent metamorphs, tadpoles), not even [illegible] new population of the Houston toad has been successfully established at APCNWR (H. Quinn, personal communication).

Lepidochelys kempi.—From 1978 through 1988, freshly deposited Kemp's ridley eggs (1000–3000/yr) were transported from Rancho Nuevo, Mexico, to Texas in an attempt to establish a new nesting colony on protected Texas beach[illegible] Eggs were incubated in sand at Padre [illegible]land and hatchlings were allowed to enter the water at Padre Island National Seashore to allow for possible imprinting on environmental cues. Hatchlings were then shipped to a National Marine Fisheries Service rearing facility at Galveston for head-starting. More than 17,000 hatchlings were imprinted at Padre Island, and >12,000 turtles have been released aft[illegible] head-starting. Details of the project, including rationale and objectives, methodology of transport, rearing, and release, numbers of turtles involved, and mortality and disease, have been outlined in a popular book (Phillips, 1989) and discussed by many papers in a symposium volume edited by Caillouet et al. (1989). The Padre Island phase of the Kemp's ridley project was terminated after the 1988 season.

Gopherus polyphemus.—The most numerous and extensive relocations and translocations of any amphibian or reptile species involve the gopher tortoise in the southeastern United States. Although thousands of animals have been moved from one area to another, particularly within Florida, in efforts to mitigate development or mining of the tortoise's remaining habitat, few details are available nd these relate to only a few projects (Bard, 1989; Burke, 1987, 1989*b*; Diemer, 1986, 1987, 1989; Doonan, 1986; Fucigna and Nickerson, 1989; Stout et al., 1989). Additional animals have been released into populations from which they did not originate after use in tortoise races (e.g., Dietlein and Smith, 1979), although this practice now has ceased. Other efforts have sought to establish populations in areas that may be outside the historic range (e.g., in the Fall Line Hills of Alabama), in isolated locations at the limits of the species' range (e.g., in Tangipahoa Parish, Louisiana), or in reclaimed phosphate mines (Godley, 1989).

Diemer (1989) reviewed relocations of gopher tortoises that occurred in Florida prior to 1987. Details were provided on nine additional relocations at a 1987 symposium sponsored by the Florida Game and Fresh Water Fish Commission (Burke, 1989*b*; Fucigna and Nickerson, 1989; Godley, 1989; Layne, 1989; Stout et al., 1989). Four studies followed tortoises 2 yr or less. Each of the four short-term relocations involved moving a group of tortoises from one or more sites to one or more different sites. Generally about 50% of relocated tortoises remained within 0.5 km 1 yr after release.

Additional details are available from two studies reported at the 1987 symposium. Burke (1987, 1989*b*) reported that 35 of 85 relocated tortoises in south Florida remained 2 yr after relocation, an "apparently stable population". Although his study was of short duration, Burke (1989*b*) concluded that tortoises could be relocated "fairly successfully" and that his work did not support social factors as influencing success rate. In a central Florida relocation (Bard, 1989; Doonan, 1986), two of 12 radio-tagged tortoises could be accounted for after 41 mo while only three of 30 non radio-tagged animals were ever recaptured after release. Seven relocated tortoises were recaptured on 11 occasions compared with 144 captures of resident tortoises on 188 occasions.

Until 1990, moving tortoises from one area to another was accepted as a conflict mitigation measure, especially for Developments of Regional Impact (DRI's), by the State of Florida, particularly in the rapidly growing central and southern regions of the state. Between 75 and 100 relocations, involving thousands of tortoises, have occurred or been authorized (D. Wood and J. Diemer, personal communication). Details concerning these relocations are unknown.

Lacerta agilis.—After a severe fire on a nature reserve in 1976, surviving sand lizards were collected. In 1978, they were moved to an outdoor vivarium. In 1981, the vivarium held a breeding colony, the purpose of which was to furnish animals for eventual reintroduction to the burned area (Spellerberg and House, 1982). Lizards were released in 1981 and recolonized the burned area. By 1988, the heathland community had recovered and sand lizards were again prevalent (Spellerberg, 1988). Details concerning follow-up sampling or lizard numbers were not presented. Other relocations and translocations of this species have occurred throughout southeastern England (primarily Dorset), and more recently in northwestern areas, for at least 20 yr. However, little information appears in the literature concerning specific details. Four populations from releases 17 yr ago continue to survive: one survives after 13 yr, two survive after 5 yr, and only two have disappeared because of fire (Corbett, 1988). A population in the Inner Hebrides continues to survive 14 yr after establishment although this area is outside the known distribution and climatic requirements for the species (Corbett, 1988).

Crocodilians in India.—Relocation efforts in India have been summarized by de Vos (1984) and Choudhury and Chowdhury (1986), including discussions of objectives, criteria for relocation, problems, and the need for monitoring the release. However, specific data on individual reintroductions and the long-term status of introduced animals is unavailable.

More than 1000 muggers (*Crocodylus palustris*) have been reintroduced in 22 locations as of 1986. As of 1986, 1022 saltwater crocodiles (*C. porosus*) had been reintroduced in India in five locations

(Choudhury and Chowdhury, 1986). Reintroduction of both species is thought to be successful.

The reintroduction of gharials (*Gavialis gangeticus*) to areas where they had been eliminated or severely reduced is touted as a major conservation achievement in India. As of 1986, 1456 gharials had been released in eight locations (Choudhury and Chowdhury, 1986). Specific details are available only for the reintroduction at the National Chambal Sanctuary where monitoring has been conducted since 1975 (Rao, 1990). In 1988, 50 nests at 15 sites were reported, and the nesting population was estimated at 50 animals (Rao, 1990). A total of 1287 captive-raised gharial have been released in the Chambal River, and the total population estimate based on 1987–1988 surveys was 804.

WHY IS MOVING ANIMALS SO POPULAR?

Because the success rate of RRT movements for conservation-related purposes is not very high, the reasons for advocating such efforts as conservation strategies should be examined. We suggest the following reasons may help to explain the advocacy of RRT movements as conservation practices, and we recommend a change in attitudes concerning these practices.

Good publicity.—Moving animals from one area to another for what promoters describe as conservation-related purposes, particularly popular species such as sea turtles and tortoises, creates favorable media attention and publicity. Media attention in turn can be used to increase the public's awareness of problems facing the species and perhaps generate funding for other less public activities such as land acquisition and basic research. However, the "30-second spot" or short newspaper story may create a false positive image for the non-involved public, affected individuals (e.g., land developers or home owners), advocacy groups, and even land managers and agency administrators. The result is a belief that such movements are a proven conservation strategy that benefits the individual animal and species. Critical examinations of relocation results and consequences are rarely part of media coverage. From a cynical point of view, positive public perception of the success of human-mediated animal movements may be desirable if alternatives are difficult to undertake or costly (see Political concerns below).

Some relocations are successful.—There have been successful conservation related RRT movements involving amphibians and reptiles (Table 1), for example, among crocodilians and for the sand lizard in Britain. Although there is not much information in the published literature, crocodilian biologists have exchanged unpublished information on relocation and reintroduction techniques through correspondence and attendance at the meetings of the Crocodile Specialist Group of the International Union for the Conservation of Nature and Natural Resources. Likewise, conservation groups in England are closely situated to exchange information on sand lizard relocations. Exchange of information has undoubtedly facilitated the success of these efforts.

Perceived successes.—Perceived successes result from inadequate information presented to the general public, inappropriate extrapolation of results from one study to other taxa, and premature reports of success.

Some individuals and organizations (e.g., Tasse, 1989) have advocated RRT movements as a conservation strategy based on limited success in a few species: for example, the Arabian oryx repatriation or the rock wallaby translocation from Australia to Hawaii. We believe such advocacy is naive and ill-informed. If two species have similar biological requirements and evolutionary history, extrapolation of the results from one taxon to the other may be initially justified. However, we do not recommend the automatic acceptance of positive results on one species as a substitute for critical experimentation and long-term monitoring of the related species. The recent publication of critical examinations of movement-related management of a wide variety of birds and mammals should serve as a caution for even within-taxon extrapolation of results (Conant, 1988; Griffith et al., 1989).

Of greater concern to us, however, is the premature claim of "success" by researchers involved with RRT movements. For instance, we fail to understand how a 50–60% desertion rate by gopher tortoises relocated in south Florida, surrounded by urban development and monitored for only 2 yr or less, can be heralded as a success and proof that relocation works (Burke, 1989*b*). Such claims give credence to the perception that RRT movements are proven management strategies that can be used to mitigate questions of habitat loss. In turn, this perception undermines efforts to protect existing habitat and appears to provide an easy way out of difficult land use questions. Until long-term studies have demonstrated otherwise, human-mediated movements of amphibians and reptiles should not be taken as proven conservation strategies, but only as experimental strategies designed to fit specific needs. Researchers should temper their claims of success with a recognition of the need for long-term evaluation. If they do not, editors should.

Lack of information on failures.—We suspect one of the most likely reasons human-mediated movements of animals for conservation purposes are continually proposed is the lack of information on what has been attempted in the past. Information on criteria for RRT movements, techniques, and results are very difficult to obtain for most studies, even those claimed as "successes". Data on negative results are virtually impossible to find. Perhaps the reasons for failure of most RRT movements are unknown. However, we consider it essential that both positive and negative results be made available in accessible sources if mistakes are to be avoided in the future.

Political concerns.—Relocation has been advocated in areas where rapid development is occurring, particularly involving tortoises in south and central Florida. Moving animals rather than killing them during construction would seem to be a humane way of dealing with problems related to habitat loss. However, most relocated or translocated animals move off the relocation or translocation site, and long-term studies have yet to demonstrate the effectiveness of these techniques. *When* the animals die becomes more important than *if* they die. In addition, commensals and other less glamorous members of the threatened community often are not considered. Rather than creating within-habitat protected areas or dealing with the larger issues of habitat protection in rapidly growing areas, relocation allows an expedient answer to a crisis demanding immediate attention. As such, relocation and translocation efforts have become the "cost of doing business" rather than well thought out strategies for effective conservation.

Humane considerations.—Concern for the fate of individual animals has sparked interest in moving them from harm's way. Concern is shown generally for the larger and more charismatic or benign reptiles, particularly tortoises, although humane reasons are sometimes used as a justification for relocating crocodilians or smaller species. Relocating animals for humane considerations can be used to foster interest in nature and involve individuals, especially young persons and the elderly, in active participation in conservation issues and activities. However, animals relocated for humane reasons should be released in accordance with the same scientific principles that guide other relocations and translocations.

Self-interest.—We have received reports that a few consultants have promoted relocation not as a measure to mitigate habitat-related conflicts, but because they want to make a large profit from the relocation. Rumors exist of consultants charging clients exorbitant fees for relocations of tortoises in south Florida (G. Dalrymple, personal communication). While we believe that most consultants operate within professional and ethical guidelines, reasons for relocating amphibians and reptiles should not be based solely on the profit to be made from the relocation. Consultants should ensure that scientific principles guide the relocation and that provisions for the long-term survival of the relocated animals are in place prior to relocation.

Recommendations

In addition to the recommendations we have made in the preceding text, the topics discussed below should be addressed prior to advocating or undertaking RRT projects for conservation purposes. Lack of clearly defined objectives, methodology, measures of success, and provisions for long-term follow-up studies is an indication of a project likely to fail. In addition, we cannot over-emphasize the need to publish the results of RRT experiments in appropriate journals. The methodology and results of both successful and unsuccessful RRT experiments need to be presented in detail to ensure that future efforts benefit from past experience. Unfortunately, it is our experience that seemingly obvious questions often are not asked during the planning stages of RRT projects.

Know Causes of Decline

A sound recovery plan for any species should start with a detailed understanding of what caused the species to become endangered or threatened. Consequently, RRT programs should only be attempted if (a) the causes of the original decline are reasonably well understood, and (b) those problems have been eliminated. In several cases, an understanding of why the species became endangered or threatened was not apparent (e.g., *Bufo houstonensis*, *Peltophryne lemur*) or was ignored (e.g., *Ameiva polops*), and these RRT programs have not been successful.

Know Biological Constraints

Although intuitively obvious, the need for RRT projects to operate within the biological constraints imposed by the species must be re-emphasized. Several projects have failed, at least in part, because of lack of attention to the biological requirements of the species (Beebee, 1983; Berry, 1986; Dodd, 1988*a*). Biological constraints to conservation are those factors that set the limits within which human-mediated actions can be taken: i.e., they comprise the animal's life history requirements. These include habitat, demographic, and biophysical components. Various authors have discussed the need to consider the biological and habitat requirements of herpetofaunal species in specific RRT projects (e.g., Bloxam, 1982; Berry, 1986; Diemer, 1989).

Habitat constraints.—We refer to habitat constraints as the physical characteristics, both macro and micro, that influence a species' presence. These include sufficient space for feeding, reproduction, cover, and social interaction of all life stages; space to allow for a population sufficiently large so that environmental fluctuation and demographic stochasticity do not lead to extinction (Soulé, 1983); food of proper nutrient content and availability, especially for herbivores; habitats free from adverse disturbance, especially from that related to human activity, roads, and predation or modification by introduced, feral, or domestic animals (especially dogs, cats, mongooses, pigs, and cattle); habitats designed to minimize "edge effects"; habitats without unnaturally large concentrations of natural predators, such as raccoons and ravens; and habitats free of toxic pollutants. Appropriate habitats should be available for all phases of the life cycle.

In addition to the size and disturbance factors above, the proper habitat must be available in sufficient quality. Factors to be considered include vegetative structure (e.g., important for gopher tortoises and many lizards), friable soils (for digging species), moisture requirements and access, access to dispersal agents (e.g., offshore currents for sea turtles), and access to symbionts (e.g., bacteria to aid gut fermentation in herbivorous species).

For wide ranging species, corridors for dispersal or migration (Harris, 1988; Harris and Gallagher, 1989) should be factored into the selection of RRT sites. Active management should be planned for RRT release sites (Griffith et al., 1989), but we caution that single species management may have detrimental effects on other sensitive species and should generally be avoided.

...*graphic constraints.*—Population ...istics of both the released animals ... animals already on-site, if any, ... be considered prior to undertaking ... projects. Factors include knowledge ... both the age and size structure of af... animals, sex ratios, and social struc... Social structure must be considered ... terms of mating system, spacing and ...ment patterns, and cannibalism.

...*ysical constraints.*—As ecto... amphibians and reptiles have ther... requirements not common to endo... RRT projects should consider ...ecialized biophysical requirements, es...ially to ensure the presence of undis...turbed basking sites. Amphibians and rep...tiles also need a proper environment for egg development (temperature, moisture, ... exchange, waste excretion, pH, ion ...tration). For species with environ... sex determination (ESD), sex ratios ... affected by the location of nest ... and season of deposition (e.g., Mro...sovsky et al., 1984; Mrosovsky and Pro...vencha, 1989; Vogt and Bull, 1984). ESD thus affects existing and future population structure. Many reptiles have ESD (Deem...ing and Ferguson, 1988), especially those ...ted for RRT projects (crocodilians, ...).

... habitat, demographic, and bio... requirements of species are care...fully considered, RRT success will be ran...dom and most likely to fail. We recommend that thorough knowledge of a species' life history requirements be a pre...requisite to the adoption of RRT strategies. The lack of information on the life histo... amphibians and reptiles, especially ...ent geographic regions, emphasiz... ...ed for basic research.

Population Genetics and Social Structure

Conservation biologists have recently ...used considerable attention on the con...cept of the minimum viable population ... Samson, 1983; Samson et al., 1985; Shaffer, 1981; Shaffer and Samson, 1985): ... number of breeding individuals in ...tion needed to avoid possible del... effects of inbreeding and loss of genetic variability as the result of drift (Simberloff, 1988). Although the exact consequences of small population size remains unclear (Simberloff, 1988), a consideration of population genetic factors is considered to be essential to successful management (Frankel and Soulé, 1981; Lande, 1988).

The RRT programs that we reviewed, with the exception of the Puerto Rican crested toad project, did not give any consideration to population genetics when planning the repatriation or translocation. Even for *Peltophryne lemur*, studies on mitochondrial DNA began long after initial repatriation attempts. Although the exact numbers of individuals used in RRT programs often are not available, in several cases (e.g., many gopher tortoise programs), the number of individuals released is clearly much smaller that the 50–500 number frequently cited as the minimum necessary to sustain a viable breeding population (see Simberloff, 1988, for a review and critique of these numbers). In addition, because many newly-released individuals do not become part of the breeding population, the actual number of animals released may need to be much higher than the theoretical effective population size. If the planners of RRT programs rejected the idea of a minimum viable population size because of a sound theoretical argument, we would have little basis for criticism. However, to neglect the subject entirely suggests either ignorance of the consequences of small population size or wishful thinking that the project may "work out" despite the small number of individuals released.

In a similar manner, we suggest that more specific attention should be devoted to the social structure of the released group of animals based on specific information from natural populations. For example, if natural populations of a species have a characteristic sex ratio, then that sex ratio should be maintained among released animals because of its potential bearing on social interactions (e.g., dominance, hierarchies, harem formation, movements away from areas). Obviously, detailed information on the life history and population ecology of the managed species is required.

Disease Transmission

There are few studies on the effects of disease on natural populations of amphibians and reptiles. However, disease may be confined to localized populations and have serious consequences, at least on a short-term basis (e.g., Dodd, 1988*b*). Of more immediate concern is the potential for introducing disease to wild populations from either captive animals released into the wild or from moving diseased animals from one population to another.

For example, disease has proved catastrophic and led, in part, to federal protection for the desert tortoise in the western Mojave Desert (U.S. Fish and Wildlife Service, 1990*b*). The disease affects the upper respiratory tract, hence the name upper respiratory disease syndrome (URDS), and combined with nutritional problems and long-term environmental stress is nearly always fatal. Preliminary work suggests that the agent is a *Mycoplasma* (Jacobson and Gaskin, 1990) that is spread from individual to individual through direct contact. URDS is common in captive reptiles (Jacobson and Gaskin, 1990), and the locations of areas where the disease was first observed suggest that it may have been introduced to wild populations from released captives.

A similar URDS has been diagnosed in the population of *Gopherus polyphemus* on Sanibel Island, Florida, and more recently near Ft. Myers and along the Tamiami Trail. While it is premature to speculate whether the disease is identical with URDS in desert tortoises, preliminary data suggest that transmission is directly from one tortoise to another, and that the disease is highly contagious and often fatal (G. McLaughlin, personal communication). Captive tortoises are known to have been released on Sanibel Island, and it is possible that the disease was introduced by a released captive. The appearance of URDS in a wild population is cause for concern, because thousands of tortoises now are routinely relocated and translocated from one area to another within Florida.

Because of the threat of disease transmission, we recommend that health checks be adopted for animals scheduled to be relocated or translocated prior to actual movement, particularly for groups such as tortoises that are known to be susceptible to contagious diseases. Release of long-term captives should always be discouraged. Health checks should include clinical evaluation using hematologic diagnosis (Rosskopf and Woerpel, 1982) by a veterinarian familiar with herpetofaunal pathology. Keeping animals in a pen or "halfway house" may increase the opportunity to observe disease problems prior to release, but may expose animals to other problems including disruption of social behavior and vandalism. Individuals from an area with known disease problems, such as Sanibel Island, should never be moved to areas where they could infect wild populations.

Need for Long-term Monitoring

There is a critical lack of information on the long-term success or failure of herpetofaunal-related RRT projects even when monitoring has been incorporated into management and conservation programs. Except for the study of gopher tortoises by Layne (1989), Aldabra tortoises in the Seychelles (Table 1), and the monitoring of crocodilian repatriation projects in India, details of reputed successes, such as with sand lizards in Great Britain, are lacking.

For the other studies that we reviewed, data are either unavailable or the projects have not been monitored long enough to evaluate success or failure. We are especially critical of claims of relocation "successes" involving long-lived species where monitoring occurred for a relatively short time. For example, Burke (1989*a*) claimed relocation had no effect on existing social structure of resident tortoises, and that tortoises could be successfully relocated (Burke, 1989*b*) despite data to the contrary on related species (Berry, 1986). He monitored relocated animals for only 2 yr at the end of which only 41% of the relocated tortoises remained on the release site. Monitoring a population of an animal for only 10% of the time it takes to reach sexual maturity hardly qualifies as enough time to measure long-term relocation "success." Likewise, we suggest that claims of success involving other tortoise relocations (e.g., Fucigna and Nickerson, 1989; Godley, 1989; Stout et al., 1989) are premature and tend to foster a false impression that relocation and translocation are proven management techniques.

Long-term monitoring of marked individuals will be required to establish the success or failure of RRT projects. What constitutes "long-term" will depend on the life-history characteristics of the species. For instance, a long-term monitoring program might continue 10–15 yr for a toad, but extend >20 yr for tortoises. Such long-term monitoring will establish not only the presence of released individuals but also the success or failure of reproduction. Long-term monitoring will ensure that release sites can maintain their integrity rather than become susceptible themselves to destruction or encroachment from "edge-effects".

We recommend that RRT projects involving amphibians and reptiles should not be attempted unless provisions are made for a biologically-based, long-term monitoring program. Considerations such as duration of monitoring that are based on non-biological priorities should not eclipse the need for evaluation within the biological constraints of the species. RRT movements should be considered experimental unless long-term studies document the feasibility of the movement on the same or a related species. Periodical evaluation is important. We caution our colleagues to exercise restraint when evaluating the "success" of such movements based on short-term monitoring and data collection.

Summary

It is not our intention to belittle any of the biologists or RRT programs reviewed in this paper. We recognize that decision-making in conservation biology often is made by non-scientists or under crisis circumstances. Nonetheless, our review casts doubt on the effectiveness of RRT programs as a conservation strategy, at least for most species of amphibians and reptiles. Although RRT programs may work under certain circumstances, they should not be used unless all parties involved are prepared to make the necessary commitment for collecting baseline data, releasing animals under appropriate circumstances, providing for follow-up studies at periodic intervals, and publishing the methodology and results of the program regardless of whether the outcome is positive or negative. If such commitments cannot be made, other conservation strategies should be considered.

Acknowledgments.—We thank J. Diemer, R. Lohoefener, R. Martin, P. Moler, H. Quinn, R. Paine, R. Reynolds, H. Snell, I. J. Stout, S. Tonge, and D. Wood for information related to relocation activities. L. Close, D. Cundall, D. Formanowicz, Jr., R. Franz, R. Jaeger, and J. P. Ross provided thoughtful comments on the manuscript.

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Accepted: 3 December 1990
Associate Editor: David Cundall

Herpetologica, 47(3), 1991, 350–357

RELOCATIONS, REPATRIATIONS, AND TRANSLOCATIONS OF AMPHIBIANS AND REPTILES: TAKING A BROADER VIEW

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THE review of "relocation, repatriation and translocation" (RRT's) of amphibians and reptiles by Dodd and Seigel (1991) provides a summary of the literature on the use of these techniques for conservation purposes. Their recommendations are generally sound, and apply not only to these conservation practices, but equally well to any of the myriad possible techniques used to help insure the preservation of a species. However, I believe that the evidence they use for support is weak, that their dissatisfaction with past efforts is only partially justified, and thus their conclusions extreme. Basically, the question that they attempt to answer is: given that conservation dollars are always limited, are RRT's cost effective and appropriate procedures for amphibian and reptile conservation programs? They find that these techniques have been successful in only a few cases, and thus they propose a rigid set of criteria to be addressed before any future attempts are begun. My comments on their work focus on two main points: whether amphibians and reptiles are generally poor candidates for RRT's, and how success should be determined.

REPTILES AND AMPHIBIANS AS RRT CANDIDATES

As Griffith et al. (1989) did for a much larger number of studies of birds and mammals, Dodd and Seigel reviewed RRT programs for 25 species of amphibians and reptiles and found that of the 11 projects that could be defined as successful or unsuccessful by their standards, five (45%) were successful. This is slightly higher than the success rate reported for 198 RRT's reviewed by Griffith et al. Even so, the use of this type of analysis is exceedingly crude, because it assumes that snakes, lizards, turtles, crocodilians, salamanders, and anurans have comparable potential for successful RRT. Certainly there is wide variation within each order as well as between them, and anyone considering an

EXHIBIT 617

Conservation Biology

Review

Suitability of Amphibians and Reptiles for Translocation

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Abstract: *Translocations are important tools in the field of conservation. Despite increased use over the last few decades, the appropriateness of translocations for amphibians and reptiles has been debated widely over the past 20 years. To provide a comprehensive evaluation of the suitability of amphibians and reptiles for translocation, we reviewed the results of amphibian and reptile translocation projects published between 1991 and 2006. The success rate of amphibian and reptile translocations reported over this period was twice that reported in an earlier review in 1991. Success and failure rates were independent of the taxonomic class (Amphibia or Reptilia) released. Reptile translocations driven by human–wildlife conflict mitigation had a higher failure rate than those motivated by conservation, and more recent projects of reptile translocations had unknown outcomes. The outcomes of amphibian translocations were significantly related to the number of animals released, with projects releasing over 1000 individuals being most successful. The most common reported causes of translocation failure were homing and migration of introduced individuals out of release sites and poor habitat. The increased success of amphibian and reptile translocations reviewed in this study compared with the 1991 review is encouraging for future conservation projects. Nevertheless, more preparation, monitoring, reporting of results, and experimental testing of techniques and reintroduction questions need to occur to improve translocations of amphibians and reptiles as a whole.*

Keywords: herpetofauna, population supplementation, reintroduction, relocation, repatriation, translocation

Aptitud de Anfibios y Reptiles para la Translocación

Resumen: *Las translocaciones son herramientas importantes en el campo de la conservación. No obstante el incremento de su uso en las últimas décadas, la efectividad de las translocaciones de anfibios y reptiles se ha debatido ampliamente en los últimos 20 años. Para proporcionar una evaluación integral de la aptitud de anfibios y reptiles para la translocación, revisamos los resultados de proyectos de translocación de anfibios y reptiles publicados entre 1991 y 2006. La tasa de éxito de las translocaciones de anfibios y reptiles reportada en ese período fue el doble de la reportada en una revisión previa en 1991. Las tasas de éxito y fracaso fueron independientes de la clase taxonómica (Amphibia o Reptilia) liberada. Las translocaciones de reptiles dirigidas por la mitigación de conflictos humanos-vida silvestre tuvieron una mayor tasa de fracaso que las motivadas por la conservación, y los proyectos más recientes de translocación de reptiles no tienen resultados conocidos. Los resultados de translocaciones de anfibios estuvieron relacionados significativamente con el número de animales liberados, los proyectos que liberaron más de 1,000 individuos fueron más exitosos. Las causas más comunes de fracasos de translocación fueron el regreso al hogar y la migración de individuos introducidos fuera de los sitios de liberación y hábitat inadecuado. En comparación con 1991, el incremento del éxito de las translocaciones de anfibios y reptiles revisadas en este estudio es alentador para futuros proyectos de conservación. Sin embargo, se requiere mayor preparación, monitoreo, reporte de resultados y experimentación de técnicas y preguntas de reintroducción para mejorar las translocaciones de anfibios y reptiles en conjunto.*

Palabras Clave: herpetofauna, reacomodo, reintroducción, repatriación, suplemento de la población, translocación

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Paper submitted June 27, 2007; revised manuscript accepted July 21, 2008.

Conservation Biology, Volume 23, No. 1, 7–15

DOI: 10.1111/j.1523-1739.2008.01123.x

Introduction

Translocations are an important tool in wildlife conservation (Griffith et al. 1989; Dodd & Seigel 1991; Fischer & Lindenmayer 2000). Thousands of translocations have occurred worldwide, although most of these have been taxonomically biased toward vertebrates, especially mammals and birds (Seddon et al. 2005). One group that has been overlooked in larger reviews of translocation programs, but which stands to reap substantial benefits from such techniques, is herpetofauna.

With further documentation of the worldwide amphibian decline and the extinction of a number of amphibian and reptile species, it is clear that proactive conservation is needed (Gibbons et al. 2000; Stuart et al. 2004; Mendelson et al. 2006). As a part of this, both translocations of wild individuals and projects coupled with captive-breeding programs appear to be growing in popularity. Furthermore, the recent Amphibian Conservation Summit listed translocations as one of 3 long-term conservation programs requiring development and implementation in the Amphibian Conservation Action Plan (Gascon et al. 2007). In addition to conservation-related motives, many other herpetofaunal translocations are being conducted to deal with human–wildlife conflicts, such as "problem" animals or building and development mitigation.

In a review of amphibian and reptile translocations, Dodd and Seigel (1991) found that amphibian and reptile projects have very low success rates, especially compared with translocations of other taxa, and they suggest that amphibian and reptile species are not suitable for translocation. Since the publication of their review, there has been wide debate in the literature (Burke 1991; Dodd & Seigel 1991; Reinert 1991; Seigel & Dodd 2002; Trenham & Marsh 2002). Despite their questionable suitability for translocation and that many amphibian and reptile species continue to undergo translocation, there has been no comprehensive review of amphibian and reptile translocations since 1991.

To improve management decisions, successes and failures of past programs need to be considered. We reviewed the results of programs published in scientific journals from 1991 to 2006 to reevaluate the suitability of amphibians and reptiles for translocation. In addition, we examined trends that may indicate key factors leading to the success or failure of projects.

Definition of Terms

Several terms have been used to refer to the release of animals into former areas within their range, including *reintroductions*, *translocations*, *relocations*, and *repatriations* (Griffith et al. 1989; Reinert 1991; Dodd & Seigel 1991; IUCN 1987, 1998). Because these terms have been used inconsistently in the literature, a recent call has been made to return to the original International Union for Conservation of Nature (IUCN) definitions outlined in the 1987 IUCN translocation position statement (Armstrong & Seddon 2008). We followed these IUCN definitions and use the term *translocation* to mean any movement of living organisms from one area to another. This includes deliberate movements of animals to establish a new population, reestablish an extirpated population, augment a critically small population, or mitigate for conflicts between animals and humans (Griffith et al. 1989; Wolf et al. 1996; Wolf et al. 1998). For the purpose of this review, we did not include releases and introductions of animals outside their natural range.

Although many projects report success, often what is being reported is only a short-term success. The ability of released animals to successfully overwinter, create burrows, or remain within a protected area does not, by itself, constitute a successful translocation program. A successful program produces a viable, self-sustaining population in the wild (Griffith et al. 1989; Dodd & Seigel 1991; IUCN 1998), and the population must be monitored for a sufficient amount of time to determine that it is self-sustaining. The amount of time necessary to do this may vary from several years for short-lived species to several decades for long-lived species (Dodd & Seigel 1991).

Here, we considered a translocation project a success if it met 2 criteria: there was evidence of a substantial addition of new recruits to the adult population due to successful reproduction at the translocation site, and the site had to have been monitored, at the very least, for the amount of time it takes that species to reach maturity. The outcome of a program was considered uncertain if monitoring time was inadequate or if there were too few data to classify it as a success or failure. We ranked projects as failures if they did not establish self-sustaining populations.

Methods

We reviewed amphibian and reptile translocation projects published in the scientific literature from 1991 to 2006, although some of the actual projects were carried out as early as the 1970s. Reports published before 1991 have been reviewed elsewhere (Dodd & Seigel 1991). We used electronic databases, reference lists, and personal contacts to find articles. Sea turtles were deliberately excluded because of the large number of projects concerning head-starting and release programs and the difficulty in relating the issues involved with their release to terrestrial and freshwater herpetofauna.

We attempted to determine the following factors for each project: species or taxonomic group being relocated; geographic region (North America, South America, Africa, Europe, Asia/Oceania) of the translocation; reason for translocation; date of release; whether founder individuals were from the wild or captivity; number of animals released; life stage of released animals (eggs, larvae, metamorphs, juveniles, subadults, adults); success of the project (as determined on the basis of our criteria); and cause of project failure.

Because of the nature of the data collected, we present the results with descriptive statistics in histograms to help illustrate trends. If a project fits into more than one category for a variable (i.e., if a project released both juvenile and adult animals), then it was counted twice. Therefore, total *n* may be greater than the total number of projects reviewed. Percentages are of the total *n*, which included projects of known (successes and failures) and uncertain outcomes.

We tested for the independence of outcomes in relation to variables with chi-square tests. For chi-square tests, we compared only projects with known outcomes (success or failure). The exception to this rule was in our evaluation of the time period (decade) during which translocations took place, for which we compared projects that succeeded, failed, and had unknown outcomes. When a contingency table had at least one expected cell frequency <5 and a chi-square test could not be used, we used a Fisher's exact test to compute a probability. Significance levels were set at $\alpha = 0.05$.

Results

We reviewed 91 translocation projects that covered 25 amphibian species and 39 reptile species. A complete table of all projects reviewed together with appropriate references is available from www.otago.ac.nz/zoology/staff/academic/bishop.html. Six of the 91 projects involved restocking into existing populations (also known as augmentation) and were not included in the main analyses, but are discussed separately. Of the 85 amphibian and reptile translocations, 38 projects (45%) consisted of translocations of amphibians and 47 projects (55%) involved reptiles. Thirty-six of these combined projects (42%) were successful. For 25 projects (29%), the long-term success was still uncertain, whereas 24 projects (28%) failed. Success and failure rates were independent of the taxonomic class (Amphibia or Reptilia) released ($\chi^2 = 0.545$, df $= 1$, $p = 0.460$; Fig. 1).

To determine whether there were any differences over time in the known and unknown outcomes of programs (success, failure, and uncertain) published since 1991, we sorted the projects into decades on the basis of when the translocation occurred. For amphibians, program outcome was independent of the decade during which the translocation was carried out ($p = 0.204$). Project results for reptiles, however, were tied to the decade in which they were carried out ($p = 0.009$), with projects carried out in recent years having higher proportions of uncertain outcomes (Fig. 2).

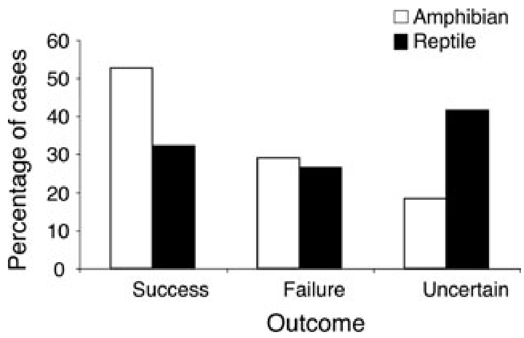

Figure 1. Outcomes of translocation projects for 38 amphibian and 47 reptile projects.

The specific reasons for translocating a species varied greatly, but could generally be grouped into one of the following: conservation, research, or human–wildlife conflict (which included development mitigation and dealing with problem animals). For amphibians, the majority of translocations were carried out for conservation reasons (89.5%), and human–wildlife conflict motivations (7.9%) and research (2.6%) made up only a small proportion of the overall reasons for carrying out a release. In the case of amphibians, the success or failure of translocations was unrelated to the reasons for conducting the release ($p = 0.480$). For reptiles, although conservation was still the leading motivation for translocation projects (74%), research projects and projects motivated by human–wildlife conflict made up 10 and 16% of the projects reviewed, respectively. Furthermore, for reptile translocations with known results, the project outcome was correlated with the program motivation ($p = 0.006$). Reptile projects carried out to deal with

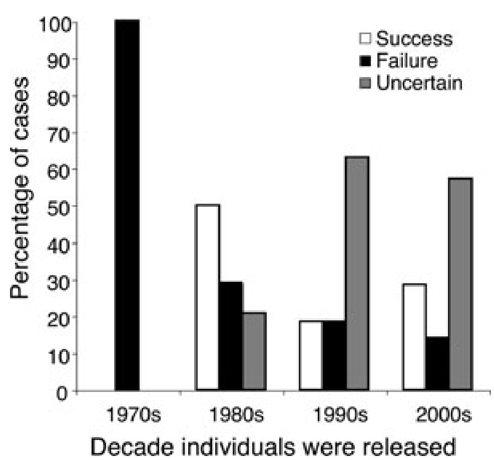

Figure 2. Outcomes of reptile translocations on the basis of the decade of animal release (1 project from 1970s, 23 from 1980s, 22 from 1990s, and 7 from 2000s).

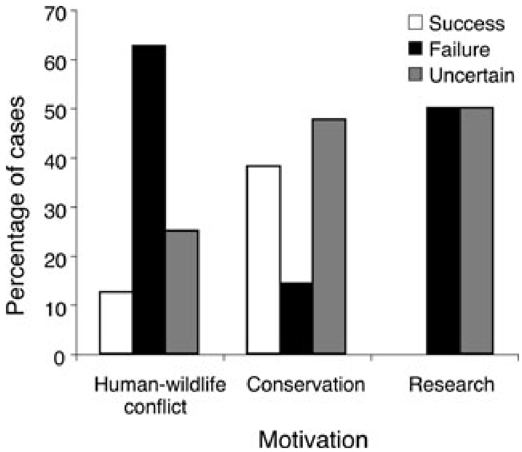

Figure 3. Outcomes of reptile translocations on the basis of motivation for the translocation (38 projects motivated by conservation reasons, 5 by research, and 8 by human–wildlife conflicts).

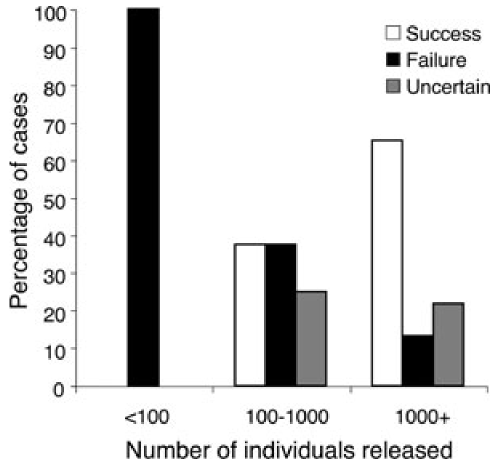

Figure 4. Outcomes of amphibian translocations on the basis of the number of individuals released (3 projects for <100 individuals, 8 projects for 100–1000 individuals, 23 projects for over 1000 individuals).

human–wildlife conflicts had the highest failure rates of the 3 motivations, whereas conservation-driven projects had the highest success rates (Fig. 3).

Most herpetofaunal translocation projects were carried out with wild individuals, with 76% of amphibian translocations and 93% of reptile translocations carried out with only wild animals. Most reptile translocations in which captive animals were used had, at present, uncertain outcomes; thus, it was not possible to determine whether the source of animals translocated had an impact on the success of the project. Nevertheless, in the case of amphibians, the source of animals reintroduced (wild, captive, or a combination) was independent of the project outcome ($p = 0.310$).

Translocation outcome was independent of life-stage category of released animals for both amphibians ($p = 0.683$) and reptiles ($p = 0.312$). Nevertheless, amphibian and reptile translocation projects used different age groups for release. For amphibians, 71% of the projects included the release of eggs, larvae, and metamorphs and 45% included the release of adults. Only 21% of amphibian translocations released juveniles. For reptile translocations, 64% of the projects incorporated the release of juveniles and subadults and 75% released adults. Only 4% of reptile translocations included the relocation of eggs.

Location had no effect on the outcome of translocations in both amphibians ($p = 0.141$) and reptiles ($p = 0.10$). The greatest number of publications on translocations were from North America for both amphibians (23 projects) and reptiles (32 projects). Australasia had the second-greatest number of publications on reptile translocations (9 projects) and Europe was second in the number of publications on amphibian translocations (9 projects).

For amphibian translocations, the number of animals released significantly affected success rates ($p = 0.008$); projects releasing over 1000 individuals were more successful than those releasing less than 100 or 101–1000 individuals (Fig. 4). The number of individuals released in reptile translocations (0–50, 51–100, or >100 individuals) was independent of project outcome ($p = 0.639$).

Of the reported causes of failure, the most common for amphibians and reptiles were homing, large movements, and migration away from the release site. Other factors, such as insufficient numbers and poaching or human collection, were evident in both failed amphibian and reptile translocations (Fig. 5). In many projects, however, the cause of failure was unknown or not reported.

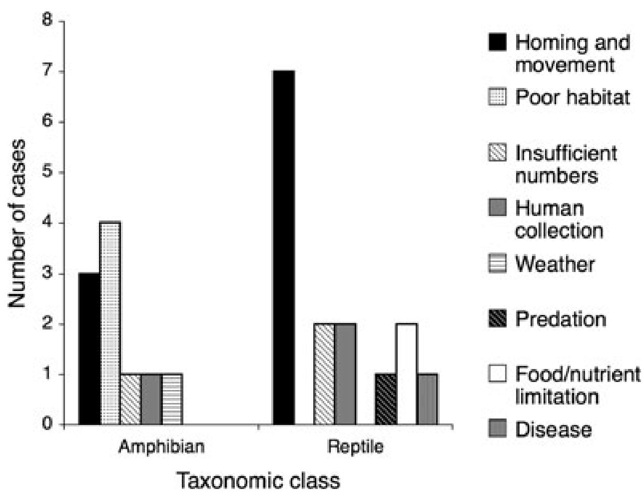

Figure 5. Reported causes of failure of amphibian and reptile translocation projects.

Of the 6 cases of restocking, 4 were carried out for conservation and 2 for research purposes. Of the conservation-motivated projects, 2 were successful and 2 had uncertain outcomes.

Discussion

Overall Review of Amphibian and Reptile Translocation Results

The proportion of successful amphibian and reptile translocation projects (41%) we reviewed from the past 15 years is double that previously reported for herpetofaunal translocations (19%; Dodd & Seigel 1991). This increase in positive results is an encouraging sign for the management and conservation of amphibians and reptiles. Nevertheless, this figure is within a similar range of reported success rates from reviews of translocations across all animal taxa (Griffith et al. 1989; Wolf et al. 1998; Fischer & Lindenmayer 2000). Even with the increase in success rates of amphibian and reptile translocations, the current figures demonstrate that room for improvement remains.

Publication bias and the reluctance of authors to report failed translocations may have caused an overestimation of true success rates (Dickerson & Min 1993; Scargle 2000). Without access to information on failed translocations, conservation managers and researchers cannot make informed decisions about the techniques to be used in future translocations.

Another issue to consider is that translocations can take years, if not decades, of monitoring to determine whether or not the project was successful. When looking at the long-term success ratings of projects by decades, the trend is that the proportion of projects with uncertain outcomes has risen dramatically in more recent projects, especially for reptiles, which include a number of long-lived and slow-to-mature species. It is nearly impossible to compare the differences in success rates of recent projects when the outcomes of such a great number of projects are unknown. Nevertheless, it does emphasize the importance of long-term monitoring. For many translocation programs, it can take 15–20 years before success can be reliably evaluated (Dodd & Seigel 1991; Nelson et al. 2002; Bell et al. 2004).

Long-term monitoring is necessary for the evaluation of projects and to determine if intervention is needed for the survival of relocated populations (Seddon 1999). Many researchers have advocated for better monitoring (Griffith et al. 1989; Dodd & Seigel 1991; Seddon 1999; Fischer & Lidenmayer 2000), and it is vital that all organizations carrying out translocations commit to the long-term monitoring essential for these projects.

Motivations for Translocation Projects

By far the greatest numbers of translocations for both amphibians and reptiles have been performed for conservation reasons. Although research and the mitigation of human–wildlife conflicts are motivations for a few amphibian projects, in reptiles they make up 16% of projects carried out. In addition, the reason behind reptile translocations was significantly linked to the project's outcome, and reptile projects carried out for conservation had the highest success rates and those driven by human–wildlife conflict were the least likely to meet our criteria for success. This trend was not found in amphibian translocations, perhaps because the sample size of nonconservation-driven projects was small.

Translocations driven by human–wildlife conflicts were usually carried out either as a mitigation effort for development projects or to transfer species that are deemed potentially dangerous to humans. Although these were some of the most unsuccessful projects reviewed, our estimates are probably conservative because it is likely that the results of many of these projects are not being reported. Companies involved in translocations for mitigation purposes may not monitor projects after release and may not report failure rates due to the fear of negative publicity (Edgar et al. 2005; Teixeira et al. 2007). In addition, outside the transfer of a population, factors such as a net loss of habitat or the quality of new habitat created for translocated animals may not currently be taken into consideration by mitigation projects. For instance, a review of great crested newt translocations used for development mitigation in the United Kingdom showed that although new ponds were created to compensate for lost ponds, the overall habitat area available to the newts had decreased (Edgar et al. 2005).

In translocations motivated by human–wildlife conflict, the survival of released animals was poor (Walsh & Whitehead 1993; Hare & McNally 1997; Rathbun & Schneider 2001; Sullivan et al. 2004; Butler et al. 2005*a*, 2005*b*). The majority of translocations of problem carnivore species, most of which were mammals, met with the same poor results for many of the same reasons as in the projects for amphibians and reptiles driven by similar motives (Linnell et al. 1997). Translocations are not an easy solution to these problems and should not be suggested as a first step in dealing with the conflicts between people and animals.

Problem animals and animals whose habitats are to be developed for human use need to be dealt with either through preventative measures or by holding the organizations moving the animals accountable for the results. If animals must be moved for development mitigation, it is essential to consider the strong homing instincts of herpetofauna and the need for appropriate release habitat both in size and quality.

Factors That Influence Translocation Success

Reviews of translocations of other taxa show that several factors often led to more successful programs. One of these has been the source of founding individuals, with translocations of wild animals being more successful than translocations of captive animals (Griffith et al. 1989; Fischer & Lindenmayer 2000). This does not appear to be the case with amphibians because the success rate was similar for wild and captive releases.

A number of traits make amphibians and reptiles good candidates for captive-release programs, including high fecundity, lack of parental care, and that numerous small-sized amphibian and reptile species can be bred in captivity in a very cost-effective manner (Bloxam & Tonge 1995). In addition, captive-bred mammals may lose natural behaviors in captivity, but some amphibians and reptiles seem to retain in captivity behavioral and physiological traits that are genetically programmed. For instance, several tests on captive rattlesnakes showed their strike-induced chemosensory searching behaviors were similar to those of wild snakes (Chiszar et al. 1993). In addition, approach distances of headstarted West Indian iguanas after release into the wild did not differ from those of wild animals of the same age, which shows they retained similar antipredator behaviors (Alberts et al. 2004). Although the source of release individuals may be less of an issue for herpetofauna than for mammals and birds, more releases are still composed of wild individuals than captive ones.

Although we found no significant difference in the outcomes of wild and captive translocations, the release of individuals held or bred in captivity added a number of issues that must be considered. It is crucial that disease risks associated with captive-breeding and release programs be considered. The risks that the released animals will transmit diseases and new parasites to wild populations and that inbreeding depression and acclimation may result in the inability of released animals to deal with such challenges in the wild (Jacobson 1993; Cunningham 1996). Recent tests of the fitness of captive-bred and wild toads show that important fitness attributes and high levels of heterozygosity can be maintained for several generations in captivity (Kraaijeveld-Smit et al. 2006). Nevertheless, other work shows that captivity can change the phenotype of animals, which may have implications for their ability to cope in a natural environment (Connolly & Cree 2008). If captive animals are to be released into the wild, these issues must be taken into account.

Another important factor to consider for translocation programs is the developmental stage of released animals. Although we found no difference in success rates, the results of several studies do suggest that certain age groups are more appropriate for translocation than others (Bloxam & Tonge 1995; Cooke & Oldham 1995; Trenham & Marsh 2002; Tocher & Brown 2004; Tocher et al. 2006). When dealing with species that show strong homing tendencies, it may be beneficial to release eggs or younger individuals rather than older adults that have had sufficient time to develop strong associations with a home site (Gill 1979; Bloxam & Tonge 1995; Semlitsch 2002; Tocher & Brown 2004). In addition, for aquatic-breeding amphibians, it may be preferable to move eggs or animals in early larval stages due to the large numbers available, which aids in ease of collection and maximizes genetic diversity. In addition, in aquatic amphibians, eggs are often available for collection from the wild for longer periods than adults, which may appear only at breeding locations for short periods (Semlitsch 2002). For many species, however, the greatest threats to individual survival come at younger life stages, when animals are more vulnerable to predators and the normal dangers of life in the wild and in these projects, so it may be better to release adults or large juveniles (Haskell et al. 1996; Nelson et al. 2002; Alberts 2007). This is particularly useful in the case of herpetofaunal species restricted to islands, where the main cause of juvenile mortality is caused by introduced mammals (Nelson et al. 2002; Alberts 2007). Outside the species-specific and logistical choices of whether to release eggs, juveniles, or adults, there is little—if any—experimental work that tests the suitability of different herpetofaunal age classes for translocation programs and the effect of developmental stage on outcomes.

A number of amphibian and reptile translocations have failed because of the release of insufficient numbers of animals (Cook 2008). When release numbers are too small, Allee effects may come into play, and the new population may fail owing to problems associated with social behavior, finding mates, and group living (Courchamp et al. 1999; Stephens & Sutherland 1999). For amphibians, translocation projects that released over 1000 individuals were the most successful, although we found no correlation between release number and outcome of reptile translocations.

For aquatic amphibians Semlitsch (2002) suggests the release of 10,000–50,000 eggs over several years to reach an adult population of 100 individuals. Nevertheless, for most herpetofaunal species, there is no easy number to use as a guideline. Several amphibian translocation programs used population modeling as a tool to make recommendations on the optimal number of animals to be captured and released (Geraud & Keinath 2004; Tocher et al. 2006). These models are most useful for species for which adequate population and life-history data are known. Although adequate release numbers are essential in birds and mammals, the relationship between number of animals released and the probability of success is thought to be asymptotic in nature, so releasing an overabundance of animals does not necessarily increase success (Griffith et al. 1989).

Quality of the release habitat and the location of this habitat within the historic range of the species (Griffith et al. 1989; Dodd & Seigel 1991) are also important factors for translocation success. If the release habitat is not of high quality, then the chances of a positive outcome are low even when all other factors are taken into consideration. Although we could not evaluate habitat quality in the publications we reviewed, poor or unsuitable habitat was one of the most often reported reasons for translocation failure.

The causes of decline must be addressed prior to the translocation of amphibians and reptiles (Dodd & Seigel 1991). For many amphibian species, this means taking action against *Batrachochytrium dendrobatidis* (the amphibian chytrid fungus) because it can cause the often fatal chytridiomycosis disease. All necessary precautions should be taken to avoid further spread of the disease through human-mediated movement of animals, and release areas for amphibians susceptible to the fungus should be amphibian-chytrid free. Any amphibian release area should also be sufficiently distant from infected areas because the amphibian-chytrid fungus spreads at a rate of up to 120–160 km/year in Australia and 28–42 km/year in Central America (Lips 1998; Alexander & Eischeid 2001; Lips et al. 2006). Recently, a few failed translocations have been traced back to chytridiomycosis, and the amphibian-chytrid fungus has been found in released toads (Fellers et al. 2007; Fisher & Garner 2007).

Future Research and Recommendations for Amphibian and Reptile Translocations

Stress affects translocated animals (Moore et al. 1991; Coddington & Cree 1995; Mathies et al. 2001; Lance et al. 2004; Alberts 2007; Teixeira et al. 2007), and even short holding periods can cause significant acute stress responses, which may exist for up to a month after release (Alberts 2007) in herpetofauna (Moore et al. 1991; Tyrrell & Cree 1998; Lance et al. 2004). A number of researchers have examined the effects of stress from capture, but few have looked at the effects of stress in herpetofauna after release into a new environment. It must be considered that individuals undergoing translocation face several stressors, including capture, captivity, and transportation, that may cause a larger "distress" effect in individuals (Platenberg & Griffiths 1999; Teixeira et al. 2007).

Released animals may be more likely to settle near release sites when they are provided with natal cues that are linked to positive experiences at an earlier life stage (Stamps & Swaisgood 2007). With this in mind, future researchers should investigate soft releases (which allow the animals a period to acclimate to their new environment [Griffith et al. 1989]), resource provisioning, and other such supportive measures to determine whether they increase the success rates of translocations. Little work has been done with natal-habitat preference or soft releases as they apply to herpetofaunal translocations, but there are a few cases that show they can increase site fidelity and translocation success for reptiles (Tuberville et al. 2005; Alberts 2007).

Although there are far fewer studies on the outcomes and effects of amphibian and reptile restocking or augmentation, such techniques may be useful for restoring genetic diversity in inbred populations or improving population recovery (Madsen et al. 1999; Muñoz & Thorbjarnarson 2000; Wilson et al. 2004).

Although the success rate of amphibian and reptile translocations has increased, further improvements are needed. More research is necessary on techniques such as soft release, on how to improve site fidelity, and on short-distance translocation and fencing off problem animals. Translocation projects should never be undertaken without thorough consideration of the ecological implications they may have on the source population, the individuals being released, and the ecosystem into which they are reintroduced. In addition, it is critical that a commitment be made to monitor the reintroduced populations over the short and long term and that these results be made available to the general public regardless of outcome through a centralized database. Without the publication of both successful and unsuccessful projects and the details involved, it is impossible for wildlife managers and scientists to make informed decisions for the future translocations of species.

Acknowledgments

We thank everyone who sent us articles and responded to questions and emails. We are also grateful to A. Cree, R. Griffiths, R. Gabrielsson, K. Hare, S. Herbert, K. Rexer-Huber, P. Seddon, and anonymous reviewers for constructive comments on previous drafts.

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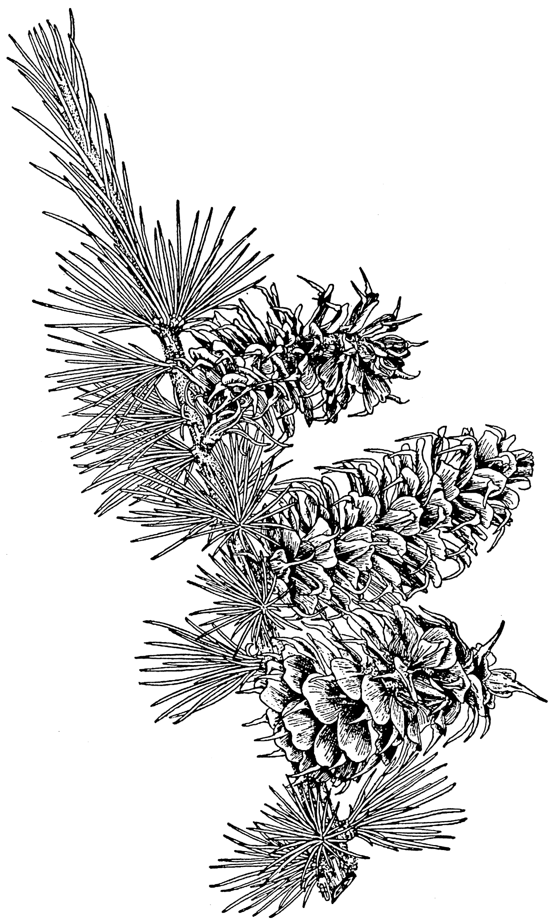

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APPLICATION FOR CERTIFICATION
FOR THE *IVANPAH SOLAR ELECTRIC GENERATING SYSTEM*

DOCKET NO. 07-AFC-5
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(Revised 3/11/10)

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DECLARATION OF SERVICE

I, Violet Lehrer, declare that on August 23, 2010, I served and filed copies of the attached, Intervenor Sierra Club's Supplemental Exhibits, dated August 23, 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/ivanpah]**.

The documents have 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, in the following manner:

(***Check all that Apply***)

FOR SERVICE TO ALL OTHER PARTIES:

__x__ sent electronically to all email addresses on the Proof of Service list;

____ by personal delivery;

____ by delivering on this date, for mailing with the United States Postal Service with first-class postage thereon fully prepaid, to the name and address of the person served, for mailing that same day in the ordinary course of business; that the envelope was sealed and placed for collection and mailing on that date to those addresses **NOT** marked "email preferred."

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CALIFORNIA ENERGY COMMISSION
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I declare under penalty of perjury that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

Original signed by:
Violet Lehrer

*indicates change