BUREAU OF LAND MANAGEMENT
LAS VEGAS FIELD OFFICE

FINAL REPORT

TO
CLARK COUNTY DESERT CONSERVATION PROGRAM
FOR THE BIENNIUM
JULY 1 2005 TO JUNE 30, 2007

RESTORATION OF CRITICAL DESERT TORTOISE HABITAT
2005-BLM-500-P

Photo: C. Ronning, BLM Wildlife Biologist

This work was supported by the Clark County Desert Conservation Program
Section 10 fund to further implement or develop the
Clark County Multiple Species Habitat Conservation Plan

PROJECT REVIEW:

What measurable goals did you set for this project and what indicators did you use to measure your performance? To what extent has your project achieved these goals and levels of performance?

Goals and Objectives of the Project:

- Promote survival of the desert tortoise in key portions of its historical range
- Control erosion to prevent topsoil loss
- Restore sites to the native vegetative community type
- Prevent further spread of exotic plant species
- Enhance landscape aesthetics and visual resource values
- Reduce fragmentation of desert tortoise habitat

These goals can be accomplished over the long-term by the meeting short-term restoration objectives. Project objectives were:

1) complete restoration on 90 disturbed sites in critical tortoise habitat administered by the BLM, and
2) monitor restoration sites to determine effectiveness of restoration treatments.

Methods and Materials:

Ninety disturbances were evaluated for restoration needs using the following criteria

- Disturbance intensity
- Disturbance frequency
- Accessibility for applying restoration techniques

Restoration techniques were employed which included: removal of trash and large debris; salvaging and transplanting cactus and yucca; planting vertical and horizontal mulch; de-compacting soils; raking out vehicle tracks; placing rocks; seeding and/or planting native perennials; and preparing sites for seed entrapment and seedling recruitment. Post-restoration, monitoring techniques were employed which included: recording restoration sites into a main database to relocate and track site characteristics; photo-documenting restoration sites for long-term changes; revisiting sites to determine their social and biological success; and measuring plant cover, density, and diversity at some restoration sites.

Results and Evidence of Results:

Objectives Completed:

Ninety sites, totaling approximately 498 acres of desert tortoise habitat received restoration treatments. The project funded a restoration team of two crew members and several periodic 10-man conservation crews that completed restoration on a total 90 disturbed sites, 37 in the Piute/Eldorado ACEC, 40 in the Coyote Springs ACEC, and 13 in the Gold Butte ACEC. All 90 restoration sites were revisited and monitored for social success and recovery.

Long-term Quantitative Monitoring Results:
Four sites restored during 2003-2004 were established as long term monitoring sites (see Effectiveness Monitoring Report for site locations and results). Sites were monitored for both social success and biological success. Social success was determined by whether the sites are still in an undisturbed condition. Biological success was measured by performing vegetation transects and soil stability tests in both disturbed and adjacent undisturbed habitat. Baseline monitoring data for these sites was measured three months post-restoration in May of 2004. Sites were then monitored in May of 2006 and 2007. The results of this monitoring are as follows:

After three years, restoration sites regained up to 17% plant cover with no detectable increase in invasive cover relative to the undisturbed community. Soil stability is now, on average, 50% of the stability in adjacent undisturbed areas, compared to 30% immediately post-restoration. Three out of four sites received post-restoration OHV use in 2005, which may slow recovery. In response to these new disturbances, additional vertical mulch was added to the front of these sites to prevent further damage. The vertical mulch additions do not effect the transect areas. This treatment seems to have been effective, as there was no sign of new disturbance during the 2007 monitoring.

During 2007 monitoring, germination of *Ambrosia dumosa, Larrea tridentata*, *Chrysothamnus viscidiflorus, Eriogonum inflatum, Sphaeralcea ambigua* and *Hymenoclea salsola* (four of which were in the seed mix applied to the sites) was evident around the vertical mulch areas of most of the sites, but was less apparent in the un-mulched transect areas. This may indicate that vertical mulch is effective at creating microsites which trap seeds and protect seedlings. Nonnative species comprised very little of the disturbed areas plant cover, but up to 40% of the understory cover when lower layers were present in the adjacent undisturbed habitats, mainly due to red brome.

When comparing 2004 and 2007 data, we see a significant increase in plant cover and soil stability on the disturbed-restored areas in 2007. These are good indicators that the sites are on the path of recovery.

Results of Short-term Monitoring of 2005-2007 Sites:
In spring of 2007, all 42 restoration sites (all sites not including the 48 burned treatment sites which were monitored separately) were revisited to determine social success of active restoration. Each site was given a rating of Undisturbed, Redisturbed, or Reopened. In Piute/Eldorado ACEC, 76% of all the sites received no post-restoration OHV traffic, 19% of all the sites were redisturbed by OHV use, and 5% of all the sites were completely reopened by OHV use. In Gold Butte ACEC, 80% of all the sites received no post-restoration traffic, 20% were redisturbed, and 0% was reopened. All sites that have been reopened or redisturbed will be prioritized for additional restoration actions to prevent further damage.

These sites were also monitored for qualitative biological success as it relates to vegetative cover. Each site was given a rating of Fully Restored, Mostly restored,

Recovering, or Not Recovering. All assessments are qualitative. Only sites that are at least 1 year post restoration received biological success monitoring since sites need at least that length of time to show any sign of change. Results of this qualitative monitoring are as follows: Of 22 sites monitored in Piute/Eldorado Valley ACEC, 0% of sites were fully restored, 5% were mostly restored, 59% were recovering, and 36% were not recovering. None of the Gold Butte sites are greater than 1 year old.

Results of Qualitative Monitoring of Old Restoration Sites

In addition to the 2005-2007 sites monitored, 230 older restoration sites were also monitored for social and qualitative biological success as it relates to vegetative cover. The same definitions for both social success (Undisturbed, Redisturbed, Reopened) and biological success (Fully restored, Mostly restored, Recovering, Not recovering) as described above were used on these older sites.

Sites range anywhere from 8 years to 2 years post restoration. The results of social success monitoring are as follows: Of 209 sites monitored in Piute/Eldorado ACEC, 62% of all the sites were undisturbed, 29% of all the sites were redisturbed by OHV use, and 9% of all the sites were completely reopened by OHV use. Of 21 sites monitored in Gold Butte ACEC, 71% of all the sites were undisturbed, 23% were redisturbed, and 6% were reopened. All sites that have been reopened or redisturbed will be prioritized for additional restoration actions to prevent further damage.

The results of biological success monitoring are as follows: Of 209 sites monitored in Piute/Eldorado Valley ACEC, 3% of sites were fully restored, 12% were mostly restored, 68% were recovering, and 17% were not recovering. Of 21 sites monitored in Gold Butte ACEC, 5% of sites were fully restored, 10% were mostly restored, 71% were recovering, and 14% were not recovering.

Did the project encounter internal or external challenges? How were they addressed? Was there something Clark County could have done to assist you?

No internal or external challenges were identified.

What lessons did you learn from undertaking this project?

- We found that using sparse vertical mulch to reclaim roads is less effective than a heavy mulching method. Most redisturbed sites had light application of vertical mulch, while the sites with very heavy mulching are intact.
- Our observations have shown that the creation of microsites, via vertical and horizontal mulch, pitting, or other methods of roughening the surface, seem to be key in reestablishing vegetation. Preparing the ground to retain seed is critical in effective restoration.
- In areas of heavy recreation, where restoration sites are repeatedly redisturbed, barriers and fences are the most effective method of gaining public compliance and preventing redisturbance.

- In some areas, it is better not to post signs at restoration site, especially if the restoration efforts make the site difficult to notice. We have found in some instances that signs actually make the site stand out and prompt noncompliant recreationists to disturb it.
- From monitoring old restoration sites, we think that ripping roads should only be done in cases of extreme compaction. The significant soil disturbance allows invasives to enter the site. For light to moderate compaction, we recommend decompacting with hand tools.
- We found that using large-sized, salvaged yuccas and cacti to reclaim 2-track trails is very successful in minimizing subsequent traffic. This method is also cost-effective, since the transplanted yuccas require very little maintenance compared with other types of transplants.
- The majority of our efforts went into performing restoration work and little was invested in public outreach. We believe that unless the amount of investment in public outreach matches or exceeds the investment in performing the restoration work, the project is at a high risk of being destroyed by the public.
- Effective habitat protection has 3 components: Law Enforcement, Public Education, and Restoration. Each component is made increasingly more effective by adding the other 2 components. By combining all three components, projects stand the best chance of success.
- Intra-agency cooperation is very important in prioritizing disturbances so that the most critical, and possibly more successful, sites are restored first.
- All redisturbed restoration sites require additional restoration work in order to recover and this should be a high priority before the sites further degrade. All reopened restoration sites should be reprioritized with other documented disturbances in order to determine if they should be re-restored. Barriers and fencing should be considered in sites that are a recurring problem.

What impact do you think the project has had to date?

Declines in desert tortoise populations are associated with high densities of access routes and vehicular traffic (Schoenwald-Cox and Buechner, 1992). Thus, by successfully minimizing access and vehicle traffic on over 48 acres of critical desert tortoise habitat, this project has effectively mitigated tortoise population decline in the Piute/Eldorado ACEC and Gold Butte ACEC. Also, tortoise forage and cover species surface microsites were reintroduced to over 450 acres of fire devastated areas in Coyote Springs ACEC and Gold Butte ACEC. Since 1999, MSHCP funding has enabled BLM to treat 252 restoration sites in critical desert tortoise habitat and other sensitive species habitat.

Is there additional research or efforts that would complement or add to your project that could be conducted?

Desert tortoise population monitoring in and around restoration sites as well as within ACECs that have received a lot of restoration work is necessary in order to accurately

assess restoration effectiveness on reducing effects on the tortoise population. All redisturbed restoration sites require additional restoration work in order to recover and this should be a high priority before the sites further degrade. All reopened restoration sites should be reprioritized with other documented disturbances in order to determine if they should be re-restored. Barriers and fencing should be considered in sites that are a recurring problem. In addition, restoration investments are at high risk being destroyed by the public unless public outreach and law enforcement matches or exceeds the investment in performing the restoration work. Management and mitigation efforts should continue to focus on a program that includes all three components: Law Enforcement, Public Education, and Restoration.

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Upland Restoration in Critical Desert Tortoise Habitat
Final Report

Executive Summary:

Featured Project and Type:

Restoration in Desert Tortoise Critical Habitat (2005-BLM-500-P). MSHCP implementation project conducted by the US Department of the Interior Bureau of Land Management (BLM).

Species Addressed:

Federally listed covered species: desert tortoise.
Non-listed covered species: glossy snake, banded gecko, sidewinder, speckled rattlesnake, Mojave green rattlesnake, Great Basin collared lizard, desert iguana, large-spotted leopard lizard, California kingsnake, western leaf-nosed snake, western chuckwalla, Sonoran lyre snake, Las Vegas bearpoppy, and threecorner milkvetch.

Summary Project Description:

The project continued restoration and monitoring activities in desert tortoise Areas of Critical Environmental Concern (ACECs). These areas were established by the BLM Las Vegas Field Office in accordance with the Desert Tortoise Recovery Plan (1994) for the protection and recovery of the desert tortoise species across nearly 1 million acres. The project would result in restoration of 90 habitat disturbance sites and monitoring of 4 long-term monitoring sites.

Project Status/Accomplishments:

Ninety sites, totaling approximately 498 acres of desert tortoise habitat received restoration treatments. The project funded a restoration team of two crew members and several periodic 10-man conservation crews that completed restoration on a total 90 disturbed sites, 37 in the Piute/Eldorado ACEC, 40 in the Coyote Springs ACEC, and 13 in the Gold Butte ACEC. All 90 restoration sites were revisited and monitored for social success and recovery. Four sites restored during 2003-2004 were established as long term monitoring sites and monitored for both social success and biological success. When comparing 2004 and 2007 data at the long term monitoring sites we see a significant increase in plant cover and soil stability on the disturbed-restored areas in 2007. These are good indicators that the sites are on the path of recovery. In spring of 2007, 42 restoration sites were revisited to determine social success of active restoration. Of 22 sites monitored in Piute/Eldorado Valley ACEC, 0% of sites were fully restored, 5% were mostly restored, 59% were recovering, and 36% were not recovering. In addition to the 2005-2007 sites monitored, 230 older restoration sites were also monitored for social and qualitative biological success as it relates to vegetative cover. Of 209 sites monitored in Piute/Eldorado ACEC, 62% of all the sites were undisturbed, 29% of all the sites were redisturbed by OHV use, and 9% of all the sites were completely reopened by OHV use. Of 21 sites monitored in Gold Butte ACEC, 71% of all the sites were undisturbed, 23% were redisturbed, and 6% were reopened. Of 209 sites monitored in Piute/Eldorado Valley ACEC, 3% of sites were fully restored, 12% were mostly restored, 68% were recovering, and 17% were not recovering. Of 21 sites monitored in Gold Butte ACEC, 5% of sites were fully restored, 10% were mostly restored, 71% were recovering, and 14% were not recovering.

Partners and/or Subcontractors:

BLM utilized Great Basin Institute personnel as Crew Leaders and the Nevada Conservation Corps for large crews when required.

Agency Project Contact:

Carolyn Ronning, BLM Las Vegas Field Office, Las Vegas, NV

Funding Amount Awarded:

$353,131

Contract Term:

07/01/2005 through 06/30/2007. Completion date: June 30, 2007.

Documents/Information Produced:

Quarterly Reports, Data Management Plan, GIS Map Restoration Sites 2005-2006, Effectiveness Monitoring Strategy, 45 Projects per year implemented, Maintain Crew Leader and Crew, Report of Long term Monitoring Sites, Transfer Data to MSHCP Repository, Annual Project Review, and GIS Map Restoration Sites 2006-2007.

Photos:

Site PV0906k before restoration treatment

Site PV0906k after restoration treatment

Introduction:

Description of the Project:

The purpose of this project is to continue restoration and monitoring activities in desert tortoise ACECs. These areas were established by the BLM Las Vegas Field Office in accordance with the Desert Tortoise Recovery Plan (USFWS, 1994) for the protection and recovery of the desert tortoise species across nearly 1 million acres. The project would result in restoration of 90 habitat disturbance sites and monitoring of 4 long-term monitoring sites.

Background and Need for the Project:

In the Mojave Desert, the natural restoration of denuded sites is very slow, often requiring well over 30 years to noticeably recover (Vasek et al., 1975). Because Mojave Desert areas can take centuries to return to a pre-disturbance state, active intervention and restoration work is typically employed to stop the source of disturbance and speed post-disturbance recovery rates.

The need for restoration action in desert tortoise ACECs is to off-set the pervasive loss of tortoise habitat from county-wide urbanization and proliferation of roads and trails from recreational use. Currently the Las Vegas BLM manages four tortoise ACECs:

- Gold Butte ACEC – 186,909 acres of public land just south of Mesquite, NV.
- Piute/Eldorado ACEC – 329,400 acres of public land surrounding Searchlight, NV.
- Mormon Mesa ACEC – 151,360 acres of public land between Moapa and Mesquite, NV.
- Coyote Springs ACEC – 75,500 acres of public land north of the US 93 and US 15 interchange.

Most of sites restored for this project were linear disturbances caused by excessive or illegal off-road vehicle (OHV) use. New OHV trails fragment tortoise habitat by destroying acres of plant cover, removing sources of food, increasing invasives, and creating soil conditions not conducive to plant recruitment, such as compaction and surface homogenization. Additionally, OHV use causes direct mortality (crushing) of tortoises.

Some of the sites restored for this project were burned areas of tortoise habitat, devastated by the 2005 wildfires. Wildfire causes direct mortality to tortoises, as well as destroys habitat by removing plant cover and forage, allowing for noxious weed invasions, and creating unstable soil conditions.

Management Action Addressed:

This project satisfies key management recommendations of the *Desert Tortoise Recovery Plan (USFWS, 1994)*, by means approved in the *Record of Decision for the Approved BLM Las Vegas Resource Management Plan and Final Environmental Impact Statement (BLM, 1998).*

- SL-1: Reduce erosion and sedimentation while maintaining or where possible enhancing soil productivity through the maintenance and improvement of watershed conditions.
- VG-2: Restore plant productivity on disturbed areas of the public lands.
- VS-1: Limit future impacts on the visual and aesthetic character of public lands.
- SS-2: Manage habitat to further sustain the populations of federally listed species so they would no longer need protection of the Endangered Species Act.
- SS-3: Manage desert tortoise habitat to achieve the recovery criteria defined in the Tortoise Recovery Plan (USFWS 1994).

Additionally, the project addresses the following actions recommended in the MSHCP.

- BLM(34): Monitor road and trail proliferation in desert tortoise ACECs…
- BLM(71): Limit motorized uses in the Piute/Eldorado 'Conserved Habitat' to designated roads and trails.
- BLM(123): Within desert tortoise ACECs…require reclamation of activities which result in loss or degradation of habitat, with habitat to be reclaimed so that pre-disturbance condition can be reached within a reasonable time frame.
- BLM(143): Rehabilitate, reclaim or revegetate areas subjected to surface-disturbing activities where feasible. When rehabilitating disturbed areas, first manage for optimum species diversity by seeding native species, except where non-native species are appropriate.
- BLM(135): Implement reseeding with native plant species and other soil stabilization and habitat restoration actions following wildfires within areas important for the conservation of covered species and where the feasibility of success is reasonably certain.
- BLM(137): Cooperate with NPS, FS, USFWS, Clark County and others on a reclamation program which will include maintaining a seed bank and live plants for rehabilitation of disturbed or burned areas in necessary.
- BLM(303): Implement a program to rehab surface disturbances including the first hundred feet or so of "closed" roads and trails within proposed desert tortoise ACECs…

<u>Goals and Objectives of the Project:</u>

- Promote survival of the desert tortoise in key portions of its historical range,
- Control erosion to prevent topsoil loss,
- Restore sites to the native vegetative community type,
- Prevent further spread of exotic plant species, and
- Enhance landscape aesthetics and visual resource values.
- Reduce fragmentation of desert tortoise habitat.

These goals can be accomplished over the long-term by the meeting short-term restoration objectives. Project objectives were:

1. complete restoration on 90 disturbed sites in critical tortoise habitat administered by the BLM and
2. monitor restoration sites to determine effectiveness of restoration treatments.

Species Addressed:
Federally listed covered species: Desert tortoise.
Non-listed covered species: glossy snake, banded gecko, sidewinder, speckled rattlesnake, Mojave green rattlesnake, Great Basin collared lizard, desert iguana, large-spotted leopard lizard, California kingsnake, western leaf-nosed snake, western chuckwalla, Sonoran lyre snake, Las Vegas bearpoppy, and threecorner milkvetch.

Methods and Materials:
Restoration treatments:
Ninety disturbances were evaluated for restoration needs using the following criteria:

- Disturbance intensity
- Disturbance frequency
- Accessibility for applying restoration techniques

Restoration techniques were employed which included: removal of trash and large debris; salvaging and transplanting cactus and yucca; planting vertical and horizontal mulch; de-compacting soils; racking out tracks; placing rocks; seeding and/or planting native perennials; and preparing sites for seed entrapment and seedling recruitment. Post-restoration, monitoring techniques were employed which included: recording restoration sites into a main database to relocate and track site characteristics; photo-documenting restoration sites for long-term changes; revisiting sites to determine their social and biological success; and measuring plant cover, density, and diversity at some restoration sites.

Long-term Monitoring Sites
Random 100 m permanent transects were established in 2004. Each site has two transects within the disturbed habitat and two transects in the adjacent, undisturbed, plant community. The point-line intersect method (Pyke et al. 2002) was used to measure species richness, nonnative cover, plant cover, and total surface cover of each transect. Dominant diversity was calculated using the Shannon index of community diversity, whereby only native, perennial shrubs were counted in the index. Soil stability was measured by randomly testing three microsites along each transect to obtain an average soil stability measure for the transect. Soil stability was determined using a rapid wetting technique (Pyke et al. 2002). Two samples were taken from each random point: a surface sample (0-0.5 cm) and a subsurface sample (0.5- 1.0 cm). The soil stability class data can range from 0 to 6, where lower values are attributed to less soil stability. All of the measured indicators (Surface Cover, Plant Cover, Nonnative Cover, Species Richness, Dominant Diversity, and Soil Stability) are positively correlated with overall site stability.

Disturbed data vs. Undisturbed data:
H_0: There will be no difference in plant cover, invasive cover, species richness, dominant diversity, or soil stability between the disturbed-restored habitat at each site and their adjacent undisturbed plant community.

Two-tailed t tests were used to analyze the response data for each site, independently. Due to high ecological variability a significance level of $\alpha = 0.10$ will be used to evaluate test results. Therefore, if $p < \alpha$, there is a statistically significant difference between the data in question.

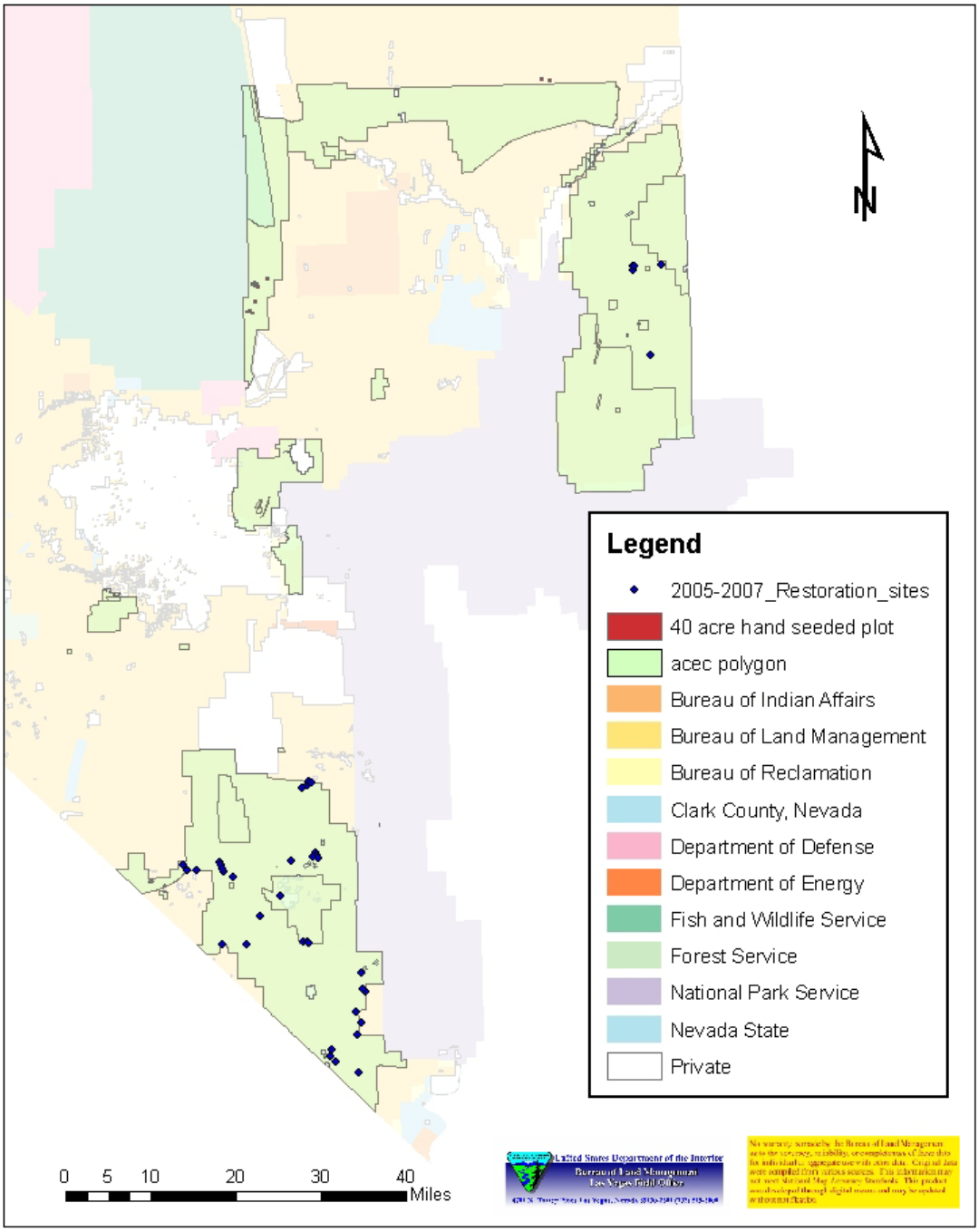
Baseline Data vs. 2-year monitoring data:
H_0: There will be no difference in plant cover, invasive cover, species richness, dominant diversity, or soil stability in undisturbed habitat among years.

A repeated measures (nonparametric alternative) test were used to analyze the response data for all sites combined, once two or more years of data are collected. Site data will be combined to assess an overall trend toward recovery. Due to high ecological variability an $\alpha < 0.10$ will be used to evaluate test results. Therefore, if $p < \alpha$, there is a statistically significant difference between the data in question.

Results and Evidence of Results:
Objectives Completed:
Ninety sites, totaling approximately 498 acres of desert tortoise habitat received restoration treatments. The project funded a restoration team of two crew members and several periodic 10-man conservation crews that completed restoration on a total 90 disturbed sites, 37 in the Piute/Eldorado ACEC, 40 in the Coyote Springs ACEC, and 13 in the Gold Butte ACEC (see Table 1). All 90 restoration sites were revisited and monitored for social success and recovery.

Evidence of Objectives/Needs Were Met/Fulfilled*:*
The locations of the 90 restoration sites are found in Figure 1 below. Following the map are photographs that show the visual condition of 11 restoration sites prior to treatment and the visible difference following restoration efforts on the ground and a table off all restoration sites (Table 1). A copy of all GIS data and project photos has been provided with the data delivery to the MSHCP Central Repository.

Figure 1. The location of 90 completed restoration sites for the 2005-2007 Biennium. Seed plots are 40 acres each for a total of 480 acres, which constitutes 48 sites total. The other 42 sites are linear disturbances shown as points on the map.



Piute/Eldorado ACEC

PVwee0306g **Before**

PVwee0306g **After**

PV0906k **Before**

PV0906k **After**

PVlor1206l **Before**

PVlor1206l **After**

PVse0906j **Before**

PVse0906j **After**

PVspv0506c **Before**

PVspv0506c **After**

Gold Butte ACEC

GBwty1206A **Before**

GBwty1206A **After**

GBmdy0107A **Before**

GBmdy0107A **After**

GBwty0107C **Before**

GBwty0107C **After**

Coyote Springs ACEC

Burned tortoise habitat, Dry Middle

Burned tortoise habitat, Dry Rock

Tortoise burrow surrounded by fire devastation

Seed Mix applied to sites

Crews seeding burned tortoise habitat

Crews seeding burned tortoise habitat

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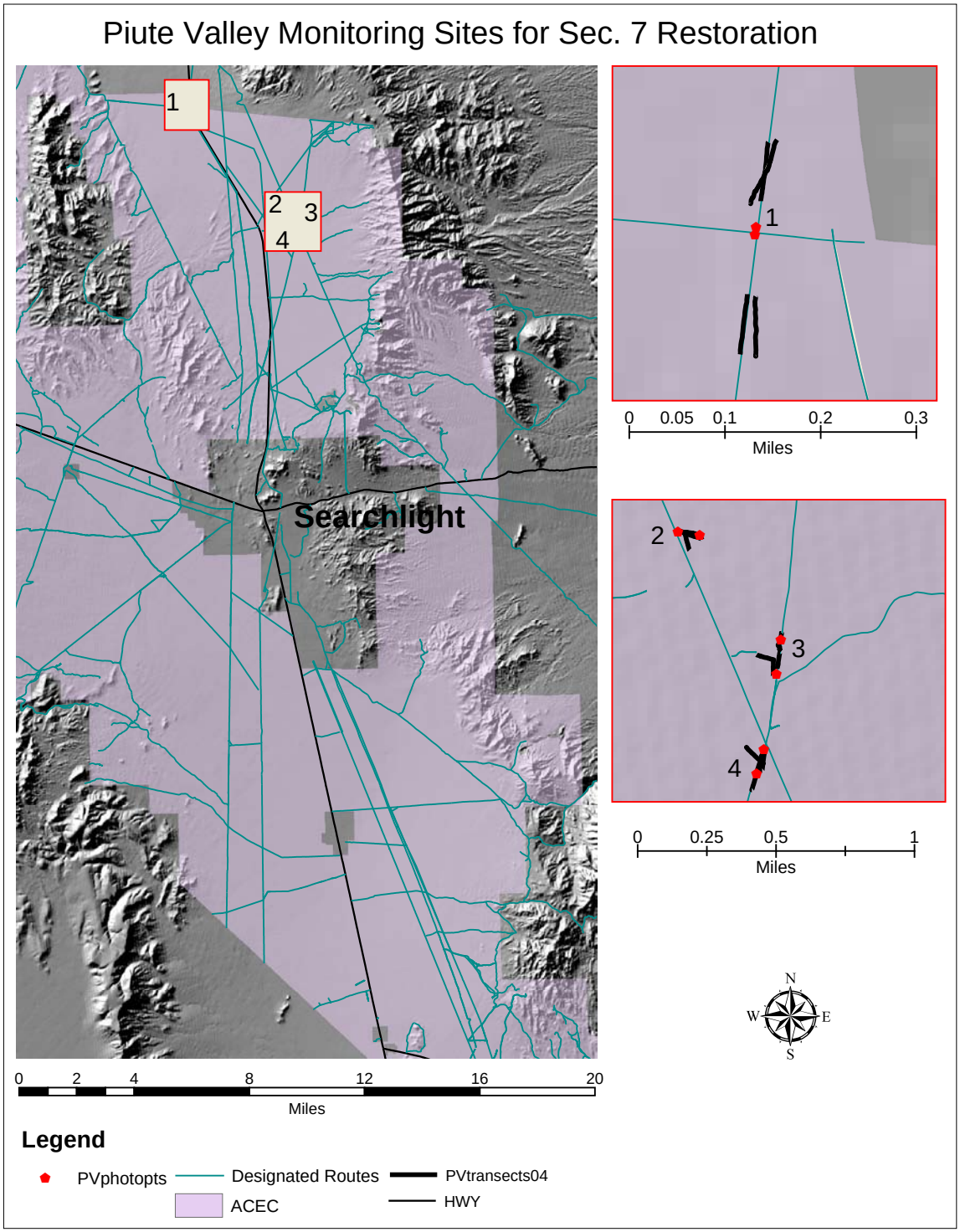
Table 1: Restoration Database of Sites Restored 2005-2007 Biennium**.** First entry constitutes 48 sites at 10 acres each that were pitted and hand seeded.

Region	Project_co	Type_	Size_	Plant_comm	ripped	seeded	vertical_m	live_trans	Pitting	rock_place	signed	other_sign	barrier	Year Rest	Monitor 6/07
Coyote Springs and Gold Butte	DT Hand Seeding	Burned	480 acres	Creosote/Bursage	No	yes	No	No	Yes	No	None	None	no	2005	
Piute Valley	PVmtb1105s1b	Incursion	0.80 acres	Creosote/other	no	no	Yes	Yes	Yes	Yes	None	None	no	2005	Redisturbed, Not Recovering
Piute Valley	PVmtb1105s1c	Incursion	0.40 acres	Creosote/other	no	No	yes	Yes	Yes	Yes	No Motor Vehicles	None	no	2005	Reopened, Not Recovering
Piute Valley	PVmtb1105s1a	Incursion	0.40 acres	Creosote/other	no	no	yes	Yes	Yes	yes	None	None	no	2005	Reopened, Not Recovering
Piute Valley	PV0315	Incursion	0.50 acres	Creosote/other	Yes	No	no	Yes	Yes	Yes	None	None	no	2005	Redisturbed, Recovering
Piute Valley	PVnsl1005C	Incursion	0.25	Creosote/other	no	No	Yes	Yes	Yes	Yes	None	None	no	2005	Undisturbed, Recovering
Piute Valley	PVnsl1005D	Incursion	0.25	Creosote/other	no	No	Yes	Yes	Yes	Yes	None	None	no	2005	Undisturbed, Recovering
Piute Valley	PVnsl1005E	Incursion	0.35	Creosote/other	no	yes	yes	Yes	Yes	Yes	None	None	no	2005	Redisturbed, Not Recovering
Piute Valley	PVnsl1005F	Incursion	0.35	Creosote/other	no	yes	yes	Yes	Yes	Yes	None	None	no	2005	Redisturbed, Not Recovering
Piute Valley	PVsws1105s3a	Incursion	4.0 acres	Creosote/Bursage	no	yes	yes	Yes	No	No	None	None	no	2005	Redisturbed, Not Recovering
Piute Valley	PVgpr1005a	Incursion	0.10 acres	Creosote/Bursage	No	No	Yes	Yes	Yes	No	No Motor Vehicles	None	No	2005	Redisturbed, Not Recovering
Piute Valley	PVse0105_5	Incursion	1.0 acre	Creosote/Bursage	no	No	Yes	Yes	Yes	Yes	No Motor Vehicles	None	no	2005	Undisturbed, Recovering
Piute Valley	PVse0105_6	Incursion	1.0 acre	Creosote/Bursage	no	No	Yes	Yes	Yes	Yes	Restoration in Progress	None	no	2005	Undisturbed, Recovering
Piute Valley	PVwee0206c	Incursion	0.20 acres	Joshua/Blackbrush	no	No	yes	Yes	Yes	Yes	Restoration in Progress	No Motor Vehicles	no	2006	Undisturbed, Recovering
Piute Valley	PVwee0206d	Incursion	0.20 acres	Joshua/Blackbrush	no	No	yes	Yes	Yes	Yes	Restoration in Progress	No Motor Vehicles	no	2006	Undisturbed, Recovering
Piute Valley	PVwee0206e	Incursion	1.20 acres	Joshua/Blackbrush	no	No	yes	Yes	Yes	Yes	Restoration in Progress	No Motor Vehicles	no	2006	Undisturbed, Recovering
Piute Valley	PVwee0206f	Incursion	0.20 acres	Joshua/Blackbrush	no	No	Yes	yes	Yes	Yes	None	None	no	2006	Undisturbed, Mostly Recovered
Piute Valley	PVwee0206g	Incursion	0.60 acres	Creosote/Other	no	No	yes	No	Yes	Yes	No Motor Vehicles	Restoration in Progress	no	2006	Undisturbed, Recovering
Piute Valley	PVwee0206b	Campsite	0.50 acres	Creosote/Other	no	No	yes	no	Yes	Yes	No Motor Vehicles	Restoration in Progress	No	2006	Undisturbed, Recovering
Piute Valley	PVwee0206a	Incursion	0.15 acres	Creosote/Other	no	No	yes	no	Yes	Yes	No Motor Vehicles	Restoration in Progress	no	2006	Undisturbed, Recovering
Piute Valley	PVspv0506a	Incursion	0.35 acres	Creosote/Bursage	no	No	Yes	no	No	Yes	No Motor Vehicles	None	no	2006	Undisturbed, Recovering
Piute Valley	PVspv0506c	Incursion	0.21 acres	Creosote/Bursage	no	No	Yes	no	No	yes	No Motor Vehicles	None	no	2006	Undisturbed, Recovering
Piute Valley	PVnip0506d	Incursion	0.75 acres	Creosote/Other	no	No	Yes	No	No	Yes	No Motor Vehicles	None	no	2006	Undisturbed, Not Recovering
Piute Valley	PVnip0506e	Incursion	1.20 acres	Creosote/Other	no	No	Yes	No	No	yes	No Motor Vehicles	None	no	2006	Undisturbed
Piute Valley	PVse0906f	Incursion	0.20 acres	Joshua/Blackbrush	no	yes	yes	Yes	No	Yes	Restoration in Progress	None	no	2006	Undisturbed
Piute Valley	PVse0906j	Incursion	0.33 acres	Joshua/Blackbrush	yes	yes	yes	yes	Yes	Yes	Restore in Progress	No Motor Vehicles	no	2006	Undisturbed
Piute Valley	PVse0906k	Incursion	0.30 acres	Creosote/Bursage	No	No	yes	yes	Yes	Yes	Restore in Progress	No Motor Vehicles	no	2006	Redisturbed
Piute Valley	PVse0906l	Incursion	0.26 acres	Creosote/Bursage	No	No	yes	yes	Yes	Yes	Restore in Progress	No Motor Vehicles	no	2006	Undisturbed
Piute Valley	PVnla120406C	Incursion	1.60 acres	Creosote/other	No	No	Yes	Yes	No	Yes	None	None	no	2006	Redisturbed
Piute Valley	PVse0906H	Incursion	0.20 acres	Creosote/other	No	No	Yes	Yes	No	Yes	None	None	no	2006	Undisturbed

Region		Type_	Size_	Plant_comm	ripped	seeded	vertical_m	live_trans		rock_place	signed	other_sign	barrier	YearRest	Monitor1
Piute Valley	PV99301206A	Incursion	0.50 acres	Creosote/Other	yes	yes	yes	yes	Yes	Yes	None	None	No	2006	Undisturbed
Piute Valley	PVlor120406G	Incursion	0.30 acres	Creosote/Bursage	No	No	yes	yes	No	Yes	No Motor Vehicles	None	no	2006	Redisturbed
Piute Valley	PVlor120406H	Incursion	0.30 acres	Creosote/Bursage	No	No	yes	yes	No	Yes	No Motor Vehicles	None	no	2006	Redisturbed
Piute Valley	PVlor120406I	Incursion	0.40 acres	Creosote/Bursage	No	No	yes	yes	No	Yes	No Motor Vehicles	None	no	2006	Undisturbed
Gold Butte	GBwtp1206A	Hillclimb	0.20 acres	Creosote/Other	No	No	yes	yes	No	Yes	None	None	no	2006	Redisturbed
Gold Butte	GBwtp1206B	Incursion	0.20 acres	Creosote/Bursage	No	No	Yes	No	No	Yes	Restore in Progress	No Motor Vehicles	no	2006	Undisturbed
Gold Butte	GBmdy0107A	Incursion	0.20 acres	Creosote/Other	no	No	yes	No	No	Yes	None	None	no	2007	Undisturbed
Gold Butte	GBwty0107B	Incursion	0.20 acres	Creosote/Bursage	no	No	yes	no	No	Yes	None	None	no	2007	Undisturbed
Gold Butte	GBwty0107C	Incursion	0.20 acres	Creosote/Bursage	no	no	yes	no	No	yes	None	None	no	2007	Undisturbed
Piute Valley	PVssl1206A	Incursion	0.30 acres	Creosote/Bursage	no	no	yes	Yes	No	yes	None	None	no	2006	Undisturbed
Piute Valley	PVssl1206B	Incursion	0.20 acres	Creosote/Bursage	no	no	yes	No	No	yes	None	None	no	2006	Undisturbed
Piute Valley	PVssl1206C	Incursion	0.20 acres	Creosote/Bursage	no	no	Yes	No	No	yes	None	None	no	2006	Undisturbed
Piute Valley	PVslt1206D	Incursion	1.0	Creosote/Bursage	No	No	Yes	Yes	No	Yes	None	None	No	2006	Undisturbed

Long-term Quantitative Monitoring:
Four sites restored during 2003-2004 were established as long term monitoring sites (see Effectiveness Monitoring Report for detailed discussion).

Figure 2. Map of the Piute Valley Area of Critical Environmental Concern (ACEC) and Long-term Monitoring sites, transects and photo points.



Sites were monitored for both social success and biological success. Social success was determined by whether the sites are still in an undisturbed condition. Biological success was measured by performing vegetation transects and soil stability tests in both disturbed and adjacent undisturbed habitat. Baseline monitoring data for these sites was measured three months post-restoration in May of 2004. Sites were then monitored in May of 2006 and 2007. The results of this monitoring are as follows:

After three years, restoration sites regained up to 17% plant cover with no detectable increase in invasive cover relative to the undisturbed community. Soil stability is now, on average, 50% of the stability in adjacent undisturbed areas, compared to 30% immediately post-restoration. Three out of four sites received post-restoration OHV use in 2005, which may slow recovery. In response to these new disturbances, additional vertical mulch was added to the front of these sites to prevent further damage. The vertical mulch additions do not effect the transect areas. This treatment seems to have been effective, as there was no sign of new disturbance during the 2007 monitoring.

During 2007 monitoring, germination of *Ambrosia dumosa, Larrea tridentata*, *Chrysothamnus viscidiflorus, Eriogonum inflatum, Sphaeralcea ambigua* and *Hymenoclea salsola* (four of which were in the seed mix applied to the sites) was evident around the vertical mulch areas of most of the sites, but was less apparent in the un-mulched transect areas. This may indicate that vertical mulch is effective at creating microsites which trap seeds and protect seedlings. Nonnative species comprised very little of the disturbed areas plant cover, but up to 40% of the understory cover when lower layers were present in the adjacent undisturbed habitats, mainly due to red brome.

When comparing 2004 and 2007 data, we see a significant increase in plant cover and soil stability on the disturbed-restored areas in 2007. These are good indicators that the sites are on the path of recovery.

SITE 1

Photo point 1: North, May 25, 2004

Photo point 2: South, May 25, 2004

Photo point 1: North, June 16, 2006

Photo point 2: South, June 16, 2006

Photo point 1: North, May 14, 2007

Photo point 2: South, May 14, 2007

SITE 2

Photo point 3: East, May 25, 2004

Photo point 4: West, May 25, 2004

Photo point 3: East, June 16, 2006

Photo point 4: West, June 16, 2006

Photo point 3: East, May 14, 2007

Photo point 4: West, May 14, 2007

SITE 3

Photo point 5: North, May 26, 2004

Photo point 6: South, May 26, 2004

Photo point 5: North, June 19, 2006

Photo point 6: South, June 19, 2006

Photo point 2: North, May 18, 2007

Photo point 6: South, May 18, 2007

SITE 4

Photo point 7: North, May 26, 2004

Photo point 8: South, May 26, 2004

Photo point 7: North, June 19, 2006

Photo point 8: South, June 19, 2006

Photo point 7: North, May 18, 2007

Photo point 8: South, May 18, 2007

Short-term Monitoring of 2005-2007 sites:
In spring of 2007, all 42 restoration sites (all sites not including the 48 burned treatment sites which were monitored separately, summary below) were revisited to determine social success of active restoration. Each site was given a rating of Undisturbed, Redisturbed, or Reopened. These social success categories were defined as follows:

Undisturbed = No tracks or evidence of disturbance, restoration still in tact.
Redisturbed = Evidence of low-intensity, low-frequency OHV use or disturbance, restoration partially damaged, but not obliterated.
Reopened = Evidence of intense and/or frequent OHV use or disturbance, all restoration is destroyed

In Piute/Eldorado ACEC, 76% of all the sites received no post-restoration OHV traffic, 19% of all the sites were redisturbed by OHV use, and 5% of all the sites were completely reopened by OHV use. In Gold Butte ACEC, 80% of all the sites received no post-restoration traffic, 20% were redisturbed, and 0% were reopened. All sites that have been reopened or redisturbed will be prioritized for additional restoration actions to prevent further damage.

These sites were also monitored for qualitative biological success as it relates to vegetative cover. Each site was given a rating of Fully Restored, Mostly restored, Recovering, or Not Recovering. All assessments are qualitative. These biological success categories were defined as follows:

Fully Restored = Plant cover indistinguishable from adjacent plant community, no signs of original disturbance apparent
Mostly restored = Plant cover ≥ 50% of adjacent plant community, original disturbance difficult to distinguish.
Recovering = Plant Cover is ≤ 50% of adjacent plant community, but germination and recruitment are apparent, disturbance is easily distinguished.
Not Recovering = Site still denuded or covered by invasive species, very little change from original disturbance.

Only sites that are at least 1 year post restoration received biological success monitoring since sites need at least that length of time to show any sign of change. Results of this qualitative monitoring are as follows: Of 22 sites monitored in Piute/Eldorado Valley ACEC, 0% of sites were fully restored, 5% were mostly restored, 59% were recovering, and 36% were not recovering. None of the Gold Butte sites are greater than 1 year old.

Qualitative Monitoring of Old Restoration sites
In addition to the 2005-2007 sites monitored, 230 older restoration sites were also monitored for social and qualitative biological success as it relates to vegetative cover. The same definitions for both social success (Undisturbed, Redisturbed, Reopened)

and biological success (Fully restored, Mostly restored, Recovering, Not recovering) as described above were used on these older sites.

Sites range anywhere from 8 years to 2 years post restoration. The results of social success monitoring are as follows: Of 209 sites monitored in Piute/Eldorado ACEC, 62% of all the sites were undisturbed, 29% of all the sites were redisturbed by OHV use, and 9% of all the sites were completely reopened by OHV use. Of 21 sites monitored in Gold Butte ACEC, 71% of all the sites were undisturbed, 23% were redisturbed, and 6% were reopened. All sites that have been reopened or redisturbed will be prioritized for additional restoration actions to prevent further damage.

The results of biological success monitoring are as follows: Of 209 sites monitored in Piute/Eldorado Valley ACEC, 3% of sites were fully restored, 12% were mostly restored, 68% were recovering, and 17% were not recovering. Of 21 sites monitored in Gold Butte ACEC, 5% of sites were fully restored, 10% were mostly restored, 71% were recovering, and 14% were not recovering.

Evaluation/Discussion of Results:

Restoration treatments:

Lessons learned from undertaking this project:

- We found that using sparse vertical mulch to reclaim roads is less effective than a heavy mulching method. Most redisturbed sites had light application of vertical mulch, while the sites with very heavy mulching are intact.
- Our observations have shown that the creation of microsites, via vertical and horizontal mulch, pitting, or other methods of roughening the surface, seem to be key in reestablishing vegetation. Preparing the ground to retain seed is critical in effective restoration.
- In areas of heavy recreation, where restoration sites are repeatedly redisturbed, barriers and fences are the most effective method of gaining public compliance and preventing redisturbance.
- In some areas, it is better not to post signs at restoration site, especially if the restoration efforts make the site difficult to notice. We have found in some instances that signs actually make the site stand out and prompt noncompliant recreationists to disturb it.
- From monitoring old restoration sites, we think that ripping roads should only be done in cases of extreme compaction. The significant soil disturbance allows invasives to enter the site. For light to moderate compaction, we recommend decompacting with hand tools.
- We found that using large-sized, salvaged yuccas and cacti to reclaim 2-track trails is very successful in minimizing subsequent traffic. This method is also cost-effective, since the transplanted yuccas require very little maintenance compared with other types of transplants.

Long-term Monitoring:
Since observations and research have shown that recovery in arid climates is very slow, the results are not surprising. In fact, the natural restoration of denuded sites often requires well over 30 years to recover noticeably (Vasek et al., 1975). Mojave Desert areas can take centuries to return to a pre-disturbance state. With this in mind, we would expect to still see significant differences between the disturbed and undisturbed areas for many years to come. Sites 1, 2, and 3 are already showing promising signs of recovery.

There was quite a bit more germination observed in the areas where vertical mulch was planted. These areas do not occur in the transects, so all observations where qualitative. This may indicate that vertical mulch is an effective treatment to create microsites to catch seeds and protect seedlings.

2004 vs. 2006
There was a significant increase in Plant Cover in disturbed areas in 2007 compared to 2004 without any significant increase in Nonnative Cover. This is a good sign, and indicates that the sites are on the path of recovery. In undisturbed areas, there was significantly less Plant Cover in 2006 and 2007 than there was in 2004. This difference is probably due to the drought in the Mojave during those years. The fact that Plant Cover on disturbed areas increased, even while overall Plant Cover was decreasing, may indicate that the disturbed sites are becoming more stable overall, allowing them to revegetate more readily.

There are statistically significant differences in Soil Stability between 2004 and 2007 for both subsurface and surface soils in disturbed areas. This is a good indication that the site is recovering and becoming more stable. There was also a significant increase in Soil Stability measures in undisturbed areas.

Keep in mind that these conclusions were obtained by averaging all site data for each year. There may be more noticeable differences if each site is analyzed individually by year. Plant Cover is still significantly lower on all disturbed sites than on the surrounding undisturbed communities. This is not surprising since recovery in arid climates is very slow and can take decades or longer to meet success standards. However, after three years since restoration, we are beginning to see a trend toward overall site recovery.

Conclusions:
Declines in desert tortoise populations are associated with high densities of access routes and vehicular traffic (Schoenwald-Cox and Buechner, 1992). Thus, by successfully minimizing access and vehicle traffic on over 48 acres of critical desert tortoise habitat, this project has effectively mitigated tortoise population decline in the Piute/Eldorado ACEC and Gold Butte ACEC. Also, tortoise forage and cover species surface microsites were reintroduced to over 450 acres of fire devastated areas in Coyote Springs ACEC and Gold Butte ACEC.

Recommendations:

- Conduct desert tortoise population monitoring in and around restoration sites as well as within ACEC's that have received a lot of restoration work in order to accurately assess restoration effectiveness on reducing effects on the tortoise population.
- The majority of our efforts went into performing restoration work and little was invested in public outreach. We believe that unless the amount of investment in public outreach matches or exceeds the investment in performing the restoration work, the project is at a high risk of being destroyed by the public. Effective habitat protection has 3 components: Law Enforcement, Public Education, and Restoration. Each component is made increasingly more effective by adding the other 2 components. By combining all three components, projects stand the best chance of success.
- Intra-agency cooperation is very important in prioritizing disturbances so that the most critical, and possibly more successful, sites are restored first.
- All redisturbed restoration sites require additional restoration work in order to recover and this should be a high priority before the sites further degrade. All reopened restoration sites should be reprioritized with other documented disturbances in order to determine if they should be re-restored. Barriers and fencing should be considered in sites that are a recurring problem.

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