

Desert Tortoise Range-Wide Monitoring (Year 5)  
Clark County, Nevada

**Final Report**



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## **EXECUTIVE SUMMARY**

Project Number: 2015-GBI-1541B

Contract Title: Desert Tortoise Range-Wide Monitoring (Year 5)

This report documents the Desert Tortoise Range-Wide Monitoring project conducted by the Great Basin Institute (GBI) in the spring seasons of 2016 - 2021. In response to the federal listing of the Mojave desert tortoise (*Gopherus agassizii*) as a threatened species, the U.S. Fish and Wildlife Service (FWS) instituted a Mojave Desert Tortoise Range-Wide Monitoring Program to track the population density of Mojave desert tortoises throughout their range. In 2021, the Clark County Desert Conservation Program (DCP) coordinated with FWS and GBI to implement line distance sampling (LDS) to monitor Mojave desert tortoise populations in the eastern Mojave Desert of southern Nevada and northwestern Arizona.

GBI has maintained the same project manager for all five years of this project and the same QA/QC-GIS data manager for the past two years. One other data manager served in the position for the first three years of the project. Additionally, GBI hired a field team consisting of five crew supervisors, 15 survey technicians, and two telemetry technicians for the 2021 season. In collaboration with FWS, GBI provided training for desert tortoise handling, field data collection, logistical support, data quality assurance/quality control (QA/QC), and GIS mapping.

Surveys for the fifth and final year of this project took place between 5 April and 18 May, 2021, in the Piute Valley, Gold Butte, and Mormon Mesa strata. Ten teams of two individuals each walked a single 12-kilometer transect per day following LDS protocol. Transect monitors completed 215 transects and observed 60 live tortoises and 67 carcasses.

Telemetry surveys corresponded with transect surveys in both location and time. Two telemetry monitors recorded multiple observations per day for a set of tortoises equipped with radio transmitters. Three telemetry sites were utilized, Piute-Mid (corresponding with Piute Valley stratum), Gold Butte (corresponding with Gold Butte stratum), and Halfway Wash (corresponding with Mormon Mesa stratum). Telemetry surveys began at least 30 minutes before transect start times each day, and continued until all transects were concluded or 4 PM, whichever came first. Telemetry monitors recorded 852 observations.

## **INTRODUCTION**

### **Project Background**

The Mojave desert tortoise (*Gopherus agassizii*) is federally listed as threatened under the Endangered Species Act (FWS 1990) and is a priority species for conservation under the Multiple Species Habitat Conservation Plan in Clark County, Nevada (Clark County 2000). The recovery program for desert tortoises requires range-wide, long-term monitoring to determine whether recovery goals are met; specifically, population trends within recovery units need to increase for a period of 25 years to warrant delisting. The purpose of this project is to conduct desert tortoise monitoring in the form of line distance sampling (LDS) across Clark County, Nevada and adjacent areas.

### **Project Description**

The Great Basin Institute (GBI) was contracted by the Clark County Desert Conservation Program (DCP) to conduct Range-Wide Monitoring using line distance sampling (LDS) surveys and corresponding telemetry surveys in Tortoise Conservation Areas (TCAs) located in the eastern Mojave Desert of southern Nevada and northwestern Arizona including: Piute Valley, Gold Butte, and Mormon Mesa. The Bureau of Land

Management, National Park Service, U.S. Fish and Wildlife Service (FWS), and Clark County/Boulder City manage land in these areas.

In 2021, GBI hired a staff of 23 biologists to conduct spring monitoring: five crew supervisors, fifteen monitors, two telemetry technicians, and one QA/QC-GIS technical support specialist. At the beginning of the season, GBI collaborated with FWS to conduct training from 1 March to 2 April. Training covered survey protocols, tortoise handling, desert safety, and GBI protocols. Monitors were assessed throughout training by a veterinarian for handling protocol, by FWS and GBI's Project Coordinator for transect protocol, and by the GBI data specialist for data collection.

Surveys took place between 5 April and 18 May in the Piute Valley, Gold Butte, and Mormon Mesa strata (Figure 1). Ten teams of two individuals each walked a single 12-kilometer transect per day, following LDS protocol. Transect monitors completed 215 assigned and alternate transects. Monitors observed 60 live tortoises and 67 carcasses.

Two telemetry monitors recorded multiple observations per day for a set of tortoises equipped with radio transmitters. The Piute-Mid site was monitored while transects were completed in Piute Valley stratum. The Gold Butte site was monitored while transects were completed in Gold Butte stratum. The Halfway Wash site was monitored while transects were completed in Mormon Mesa stratum. Telemetry surveys began each day 30 minutes to an hour before transect start times, and continued until all transects were concluded, or 4 PM, whichever came first. Telemetry monitors recorded 852 observations. Additionally, telemetry surveys were conducted in the River Mountains site to collect monthly locations of telemetered tortoises.

Data were collected by the data specialist at the end of each week and were examined for errors and inconsistencies. Data were then sent to FWS for further examination and assessment. Data was submitted to Clark County HCP in accordance with the deliverable schedule with a final database submitted at the end of the field season.

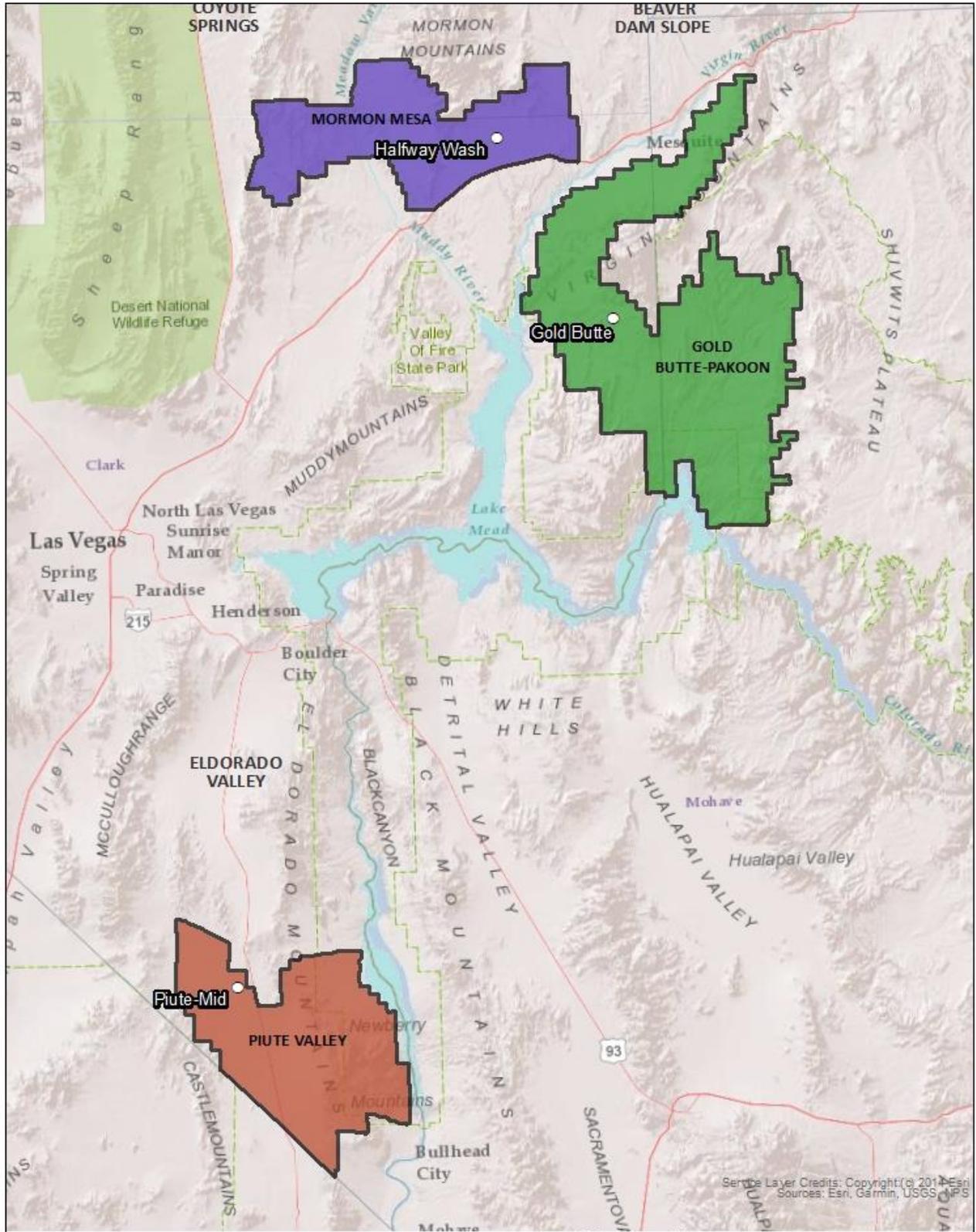
### **Project Goals and Objectives**

The overarching goals for this project are to:

- Generate three yearly estimates of Mojave desert tortoise population density in each TCA over a five-year period
- Maintain data quality, accuracy, and precision of density estimates
- Reduce variance and observer (monitor) errors during data collection

The specific goals of Year 5 of this project were to:

- Survey 215 transects in three specified strata
- Collect data on live tortoise and carcass observations
- Collect data on radio transmitter-equipped tortoises at three telemetry sites, in conjunction with transect surveys
- Collect data on radio transmitter-equipped tortoises on a monthly basis at an additional fourth telemetry site, and replace transmitters as needed



GBI Range-Wide Monitoring Year 5  
**SURVEY STRATA BOUNDARIES**

**Survey Strata Telemetry Sites**

- MM
- PV
- GB
- Halfway Wash
- Piute-Mid
- Gold Butte

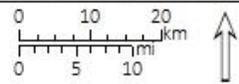


Figure 1. Location of transect strata and telemetry sites (GBI 2021)

## **METHODS AND MATERIALS**

### **Training**

Monitors were trained on proper tortoise handling, LDS protocols, GBI protocols, and desert safety, which included a two-day wilderness first aid course.

Tortoise handling was taught with limited contact of live tortoises. Monitors recorded practice data from tortoises as they would in the field. Monitors were evaluated by staff from GBI, FWS, and a veterinarian on their ability to follow handling protocols.

The LDS protocols training covered how to: use GPS and compasses for navigation, calculate transect start points, reflect transects for human-made obstacles, record data in paper and electronic formats, when to collect the required data, and develop a search image for tortoises and carcasses.

A training course was set up to determine monitors' rate of detection. The course consisted of 288 tortoise models made from Styrofoam and concrete, placed at known locations along 12 two-kilometer long transect lines marked by colored poles. Each team was asked to record observations on an 8-kilometer trial and a 16-kilometer trial (over two days) so that FWS could provide feedback about each team's search pattern and ultimately build a detection curve for each team based on the observations that were recorded. The detection curve was used in the post-season analysis.

Once detection curves were built, teams completed practice transects at the Large-Scale Translocation Site near Jean, NV. Data was assessed by GBI and FWS staff for accuracy, completeness, and consistency.

### **Transects**

The goal of conducting Range-Wide Monitoring was to acquire an unbiased estimate of the density and abundance of desert tortoises in a given area. Achieving this required integration of various field activities, but most directly, it required the ability to define the transect, locate tortoises, and accurately measure the distance from the transect line to the tortoise.

Each transect was assigned as a 3x3 kilometer square with sides running in cardinal directions. Teams surveyed the perimeter of the square and were allowed to interrupt sections where the terrain was impassible or to reflect away from human-made obstacles or stratum boundaries; these were considered non-standard transects (Figure 2). Teams collected GPS locations, referred to as waypoints, roughly every 500 meters so that the analysts could later define the transect path. Teams were comprised of two monitors that were paired together for the duration of the season. They surveyed in a single-file path along the transect, separated by 25 meters. Monitors used compasses and navigational GPS units to navigate to and along the transects. All transects in a stratum were completed before teams moved on, as a whole, to the next stratum.

Transect start-times, based on weather forecasts and observations from telemetry surveys, were determined by the project coordinator and FWS staff. Teams were to begin walking transects exactly at the determined start-time.

Transects were generated across each stratum using Geographic Information Systems (GIS) software. The number of transects to be walked in each stratum was defined in the scope of work. There are more transects in each stratum than were actually assigned. FWS used random computer generation to determine the assigned transects and the order in which they were to be walked. The QAQC-technical support specialist used GIS to determine whether the assigned transects were walkable, based on road access and terrain. Those that were not walkable were dropped and replaced with alternates.

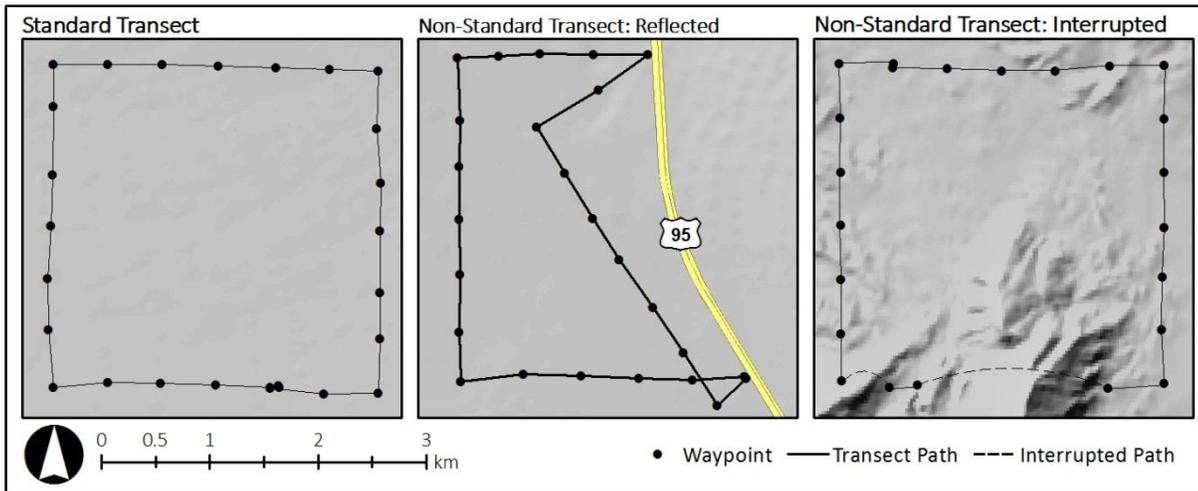


Figure 2. Examples of standard and non-standard transects (GBI 2017)

### Observations

Teams recorded information for live tortoises and carcasses found on and off the transect paths. When either was observed, the team collected location information and made a series of measurements from the transect path to the tortoise that were used later in analysis.

For live tortoise observations, teams recorded the visibility and behavior upon initial observation, measured the mid-line carapace length (MCL), determined the sex, and assigned a body condition assessment score. When possible, all live tortoises were marked using a paper tag with a unique FWS number (Figure 3). Tortoises were handled with minimal contact by one individual wearing single-use gloves (Figure 4). All equipment that came into contact with an animal was disinfected with a chlorhexidine and water solution (one ounce concentrated chlorhexidine per one gallon of water). Tortoises were not handled if the ambient shaded temperature was over 35° Celsius, if they were too deep in a burrow, or if they were engaged in social interaction.

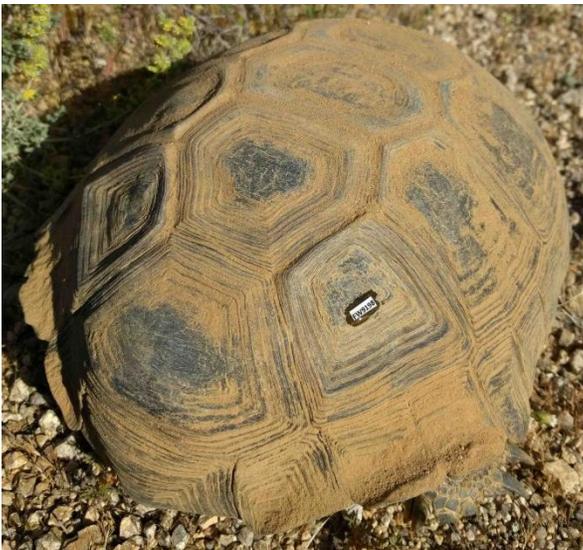


Figure 3. Tortoise with newly applied paper tag



Figure 4. Demonstration of tortoise handling with single-use nitrile gloves

Carcass observations were only recorded when more than half the shell was present (Figure 5). If the carcass was not sufficiently intact to measure the MCL, it was considered to be disarticulated and the team estimated the MCL to be greater or less than 180 millimeters (Figure 6). If it was intact, the team measured the MCL and, when possible, recorded sex and searched the carcasses for evidence of ID tags.

Tortoises observed while walking to or from a start point, driving to a transect, or at camp were recorded as opportunistic. Data from opportunistic observations are useful, but ultimately not included in the teams' final detection curve.



Figure 5. Intact carcass



Figure 6. Disarticulated carcass

## Telemetry

The goal of conducting telemetry surveys was to gather information to estimate the proportion of the tortoises in the local area that were active or visible. Telemetry surveys were conducted in conjunction with LDS surveys; as transect surveys moved to new strata, telemetry surveys moved to corresponding sites. This season, telemetry surveys were conducted at three sites that contained small groups of tortoises equipped with radio transmitters: Piute-Mid (corresponding with Piute Valley stratum), Gold Butte (corresponding with Gold Butte stratum), and Halfway Wash (corresponding with Mormon Mesa stratum). Tortoises were observed between two and four times per day on average by the telemetry monitor using a VHF receiver and directional antenna. For each observation, the monitor recorded the location, visibility, and behavior of the tortoise. Telemetry monitors began observations each day at least 30 minutes before designated transect start times and continued until all transects were completed, or 4 PM, whichever came first.

Additional tracking surveys were conducted at the River Mountain site on a monthly basis. Tortoise locations were recorded, minimally, once per month, year-round, and transmitters were replaced as needed.

## Data Processing

Data were recorded in the field on paper datasheets and in an electronic data collection application on Google Nexus 5X smartphone devices. At the end of each field day, teams exchanged and reviewed each other's paper and electronic data to verify consistency of data collection. At the end of each week, paper datasheets were collected, and the electronic data was uploaded into a Pendragon Forms database. Data were then downloaded from the Pendragon database into a Microsoft Access database where they were verified, examined for errors, and corrected using automated QA/QC scripts and visual checks. The database was then sent to FWS who reviewed the data further and sent back an assessment of data quality and protocol compliance.

## RESULTS

### Objectives Completed

- All assigned transects were completed
  - 215 transects were completed in the Piute Valley, Gold Butte, and Mormon Mesa strata
- Data were collected on live tortoise and carcass observations
  - 60 transect live tortoise observations
  - 67 transect carcass observations
- Data were collected on radio transmitter equipped tortoises at Piute-Mid, Gold Butte, and Halfway Wash sites in conjunction with transect surveys
  - 852 observations
  - 26 days of observations
- Data were collected on additional radio transmitter-equipped tortoises on a monthly basis at the River Mountains site

### Transects

In 2021, 215 transects were completed in the Piute Valley, Gold Butte, and Mormon Mesa strata and were surveyed in that order (Table 1). Transects were generally walked 4 days a week from 5 April to 18 May. A total of 42 assigned transects were replaced with alternates: 31 due to rough terrain, 7 due to lack of road access, and 4 for logistical reasons. Start time was 7 AM for the first three weeks of the season and changed to 8 AM for the last three weeks of the season. Teams walked 87 standard transects and 128 non-standard transects (Table 2). Teams collected 5,378 waypoints and walked an estimated 2,264 kilometers (Table 3).

Table 1 Summary of completed transects, assigned and alternate, during the 2021 field season

<b>Stratum</b>	<b>Completed Assigned</b>	<b>Completed Alternate</b>	<b>Total Completed</b>	<b>Total Assigned</b>
Piute Valley	51	9	60	60
Gold Butte	64	26	90	90
Mormon Mesa	58	7	65	65
Total	173	42	215	215
<b>Project Total</b>	<b>956</b>	<b>177</b>	<b>1,133</b>	<b>1,133</b>

Table 2 Standard and non-standard transects by stratum during the 2021 field season

<b>Stratum</b>	<b>Standard</b>	<b>Non-Standard</b>	<b>Total Transects</b>
Piute Valley	34	26	60
Gold Butte	32	58	90
Mormon Mesa	21	44	65
Total	87	128	215

Table 3 Number of waypoints collected and estimated distance walked by stratum during the 2021 field season

<b>Stratum</b>	<b>Number of Waypoints</b>	<b>Distance Walked (km)</b>
Piute Valley	1,540	663
Gold Butte	2,213	918
Mormon Mesa	1,625	683
Total	5,378	2,264

## Tortoises

In 2021, 60 live tortoises were observed on transects, and 11 additional tortoises were observed opportunistically for a total of 71 tortoises observed (Table 5). Of the total observed, 36 were not handled (Table 6), 1 voided, 14 had a MCL measurement of less than 180 millimeters, and 1 had an existing tag.

Table 4 Tortoises observed on transects and opportunistically during the 2021 field season

Stratum	Transect Tortoises	Opportunistic Tortoises	Total Tortoises
Piute Valley	27	4	31
Gold Butte	15	7	22
Mormon Mesa	18	0	18
Total	60	11	71
<b>Project Total</b>	<b>427</b>	<b>83</b>	<b>510</b>

Table 5 Tortoises observed, but not handled during the 2021 field season

Stratum	Too Small	Deep in Burrow	Temperature	Social Interaction	Other	Total
Piute Valley	4	13	0	0	1	18
Gold Butte	4	7	0	0	0	11
Mormon Mesa	1	5	1	0	0	7
Total	9	25	1	0	1	36

## Carcasses

In 2021, 67 carcasses were observed on transects and 8 carcasses were observed opportunistically (Table 8). Of the total carcasses observed, none had an existing tag, 29 were intact (Table 9), and 18 were estimated to have an MCL measurement of less than 180 millimeters.

Table 6 Tortoise carcasses observed on transects and opportunistically during the 2021 field season

Stratum	Transect Carcasses	Opportunistic Carcasses	Total Carcasses
Piute Valley	20	3	23
Gold Butte	12	1	13
Mormon Mesa	35	4	39
Total	67	8	75
<b>Project Total</b>	<b>315</b>	<b>37</b>	<b>352</b>

Table 7 Intact and disarticulated carcasses observed on transects during the 2021 field season

Stratum	Intact	Disarticulated
Piute Valley	12	11
Gold Butte	5	8
Mormon Mesa	12	27
Total	29	46

## Telemetry

In 2021, 852 observations of tortoises equipped with radio transmitters were recorded by two telemetry technicians over 26 days for a total of 32.8 observations per day (Table 11).

Table 8 Observations of tortoises by telemetry monitors during the 2021 field season

<b>Stratum</b>	<b>Transmitter Equipped Tortoises</b>	<b>Days Surveyed</b>	<b>Observations</b>	<b>Average Observations per Day</b>
Piute-Mid	13	6	318	53.0
Gold Butte	11	11	319	29.0
Halfway Wash	11	9	215	23.9
Total	35	26	852	32.8
<b>Project Total</b>	<b>29 (Avg.)</b>	<b>136</b>	<b>5,461</b>	<b>40.2</b>

## DISCUSSION

In an effort to complete transects in remote areas, backcountry basecamps were established and extra time was allotted for teams to access the transects. This, in addition to personnel injuries, necessitated the retention of one field team at the end of the season to complete two remaining transects. Overall, teams were successful in properly implementing protocols and finding tortoises and carcasses on the transects.

Telemetry observations corresponded well with transect surveys and were helpful in determining transect start times. Telemetry monitors were able to track tortoises repeatedly throughout the day and had an adequate number of daily observations.

## CONCLUSION

All transects were effectively surveyed before the spring season concluded, with successful results. Telemetry monitoring corresponded well with transect walk times and dates and was an effective tool in determining transect start-times and tortoise visibility.

Data errors were corrected within the correction database and submitted to the DCP in accordance with the deliverable due date.

## RECOMMENDATIONS

During the planning stages of this season the recommendations from prior seasons were put into action; transects were examined in GIS for proper reflections for known man-made obstacles and stratum boundaries and transects in remote areas were assigned basecamps ahead of time. It is recommended that these recommendations are adhered to in future seasons.

## LITERATURE CITED

Clark County. 2000. Final Clark County Multiple Species Habitat Conservation Plan and Environmental Impact Statement for Issuance of a Permit to Allow Incidental Take of 79 Species in Clark County, Nevada. September 2000.

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