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ECOLOGICAL MONITORING AND COMPLIANCE PROGRAM

2024 REPORT

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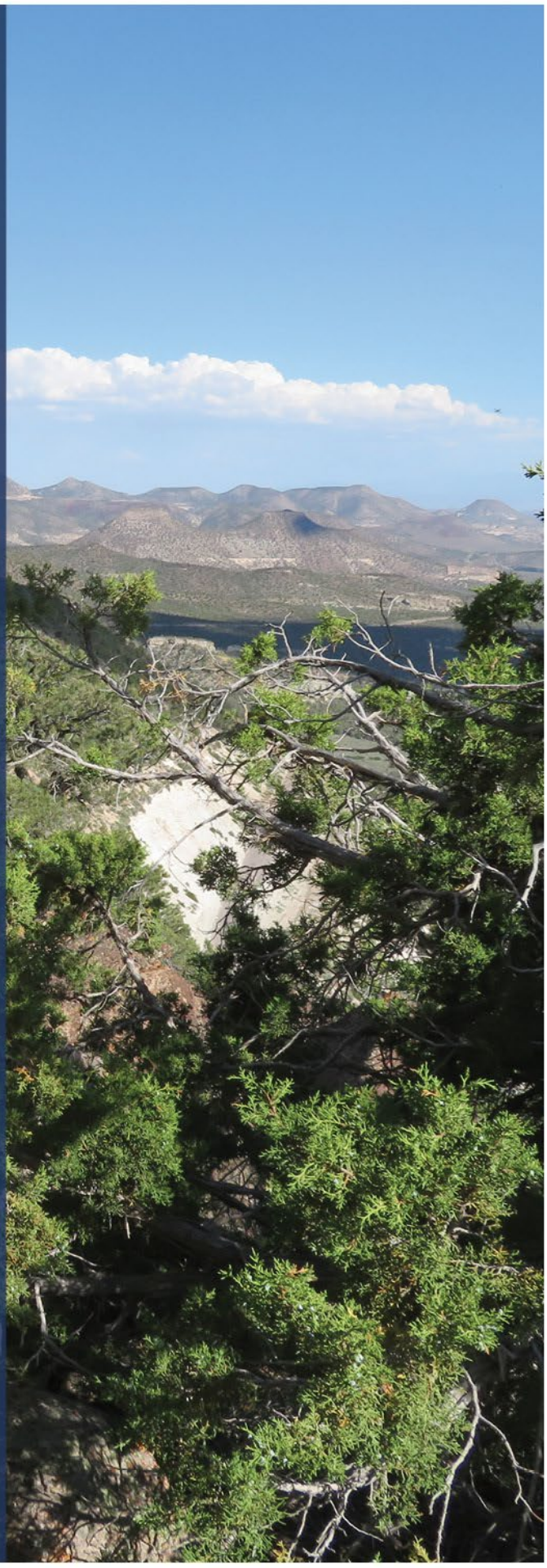

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2024 REPORT

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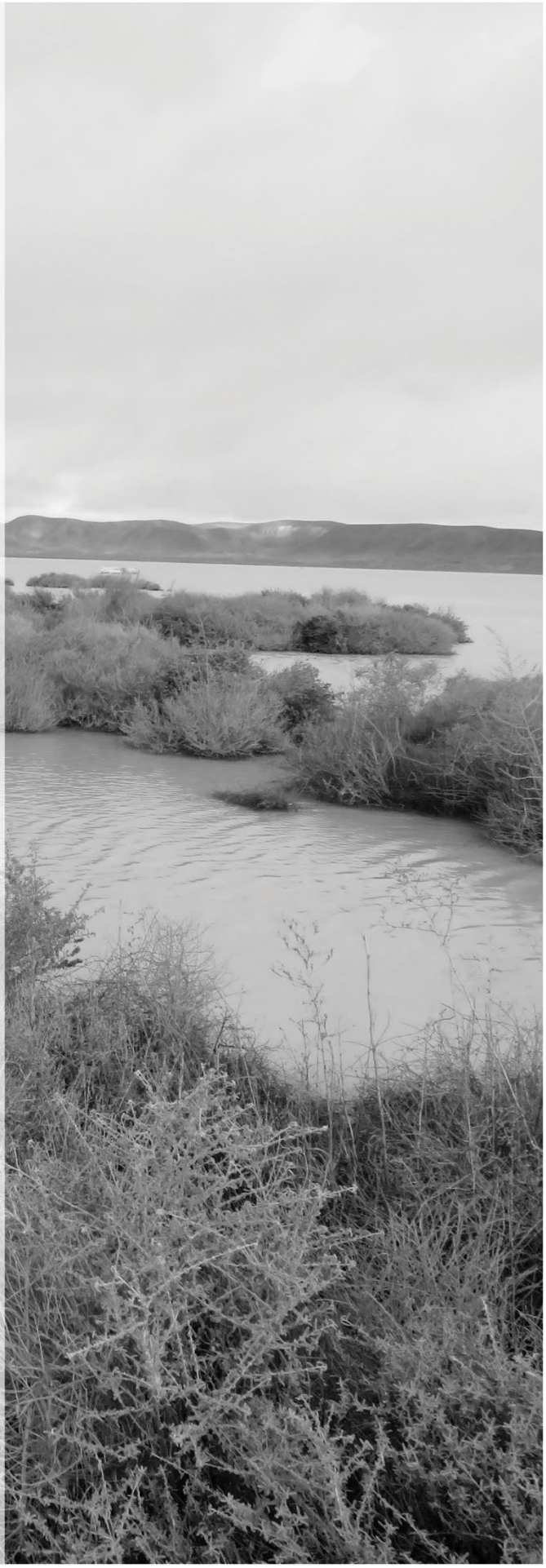

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EXECUTIVE SUMMARY

The Ecological Monitoring and Compliance Program (EMAC), funded through the United States Department of Energy, National Nuclear Security Administration Nevada Field Office (NNSA/NFO), monitors the ecosystems of the Nevada National Security Site (NNSS) and ensures compliance with laws and regulations pertaining to NNSS biota. This report summarizes the program's activities conducted by Mission Support and Test Services, LLC (MSTS), during calendar year 2024. Program activities included (a) biological surveys at proposed activity sites, (b) desert tortoise compliance, (c) ecosystem monitoring, (d) sensitive and protected/regulated plant monitoring, (e) sensitive and protected/regulated animal monitoring, and (f) habitat restoration implementation and monitoring. During 2024, all applicable laws, regulations, and permit requirements were met except for one instance of unauthorized surface disturbance and a permit violation on the Nevada Department of Wildlife (NDOW) Scientific Collection Permit #261454. Both violations were self-reported to the appropriate regulators and steps were taken to prevent these from happening again.

Sensitive and protected/regulated species of the NNSS include 43 plants, 1 mollusk, 2 insects, 2 reptiles, 242 birds, and 31 mammals. These species are protected, regulated, or considered sensitive according to state or federal regulations and natural resource agencies and organizations. The desert tortoise (*Gopherus agassizii*) is the only species on the NNSS protected under the Endangered Species Act and is listed as threatened. Biological surveys for the presence of sensitive and protected/regulated species and important biological resources on which they depend were conducted for 22 projects. A total of 113.1 hectares (ha) was surveyed for these projects. Some of the sensitive and protected/regulated species and important biological resources found during the surveys included: five tortoise burrows (avoided or collapsed); relocation of five horned lizards (*Phrynosoma platyrhinos*); seven inactive bird nests (avoided or removed); 24 chukar (*Alectoris chukar*); ungulate sign (pronghorn antelope [*Antilocapra americana*], feral burro [*Equus asinus*], and mule deer [*Odocoileus hemionus*]); Monarch butterfly (*Danaus plexippus*) habitat (milkweed [*Asclepias erosa*]); yucca plants (Joshua tree [*Yucca brevifolia*] and Mojave yucca [*Yucca schidigera*]); and multiple cactus species. NNSS biologists communicated with ground crews and provided written summary reports to project managers of survey findings and mitigation recommendations when applicable.

Twelve tortoise clearance surveys were conducted by NNSS biologists. No tortoises were observed, reported injured or killed during projects. A total of 22.3 ha of tortoise habitat was disturbed during project activities. All projects that were monitored within tortoise habitat remained within the surveyed project area. There were 40 reported tortoise roadside observations and no reported roadkill. Many of the sightings were the same tortoise observed multiple times. Juvenile tortoises continued to be monitored as part of a collaborative effort to study survival of translocated animals. After 148 months post-release, 10 of the 60 tortoises (16.7%) (4 female, 6 male) were known to be alive and doing well.

From 1978 to 2024, an average of 9.8 wildland fires per year and about 125 ha per fire have burned on the NNSS. Many wildland fires are caused by lightning and do not occur randomly across the NNSS but occur more often in particular vegetation types (e.g., blackbrush and pinyon pine/Utah juniper/sagebrush species [*Pinus monophylla/Juniperus osteosperma/Artemisia* spp.] plant communities). These vegetation types have sufficient woody and fine-textured fuels that are conducive to ignition and spread of wildland fires. Once a site burns, it is much more likely to burn again because of the invasive annual plants that quickly colonize these areas (Brooks and Lusk 2008). Five wildland fires were documented on the NNSS in 2024. Three were human-caused or project related, one was caused by lightning, and one was caused by an unknown source. Ribbon Cliff Fire was the largest and burned approximately 3,228 ha in primarily sagebrush habitat in Area 20. The remaining fires were all <0.5 ha in size.

Wildlife use at 10 natural water sources (6 springs, 4 rock tanks) and 4 constructed water sources (1 well pond, 2 water troughs, and 1 radiologically contaminated sump) was documented using motion-activated cameras.

There are currently 19 vascular plants and 1 non-vascular plant included in the NNSS sensitive plant monitoring program. The Nevada Division of Natural Heritage increased the number of sensitive plants they are actively tracking the status and distribution of by combining the Tracking and Watch lists. No changes will be made to the NNSS sensitive plant monitoring program until the species added to the tracking list are evaluated for their status on the NNSS, in Nevada, and in other states. A species evaluation was completed for white-margined beardtongue (*Penstemon albomarginatus*). Long-term monitoring of Beatley's milkvetch (*Astragalus beatleyae*), sanicle biscuitroot (*Cymopterus ripleyi* var. *saniculoides*), and white bearpoppy (*Arctomecon merriamii*) was performed. Sensitive plant fact sheets were updated and posted for public viewing for each sensitive vascular plant.

Surveys of sensitive and protected/regulated animals in 2024 focused on birds, bats, feral horses (*Equus caballus*), mule deer, pronghorn antelope, desert bighorn sheep (*Ovis canadensis nelsoni*), and mountain lions (*Puma concolor*). Additional information is presented about Mojave poppy bee (*Perdita meconis*) surveys, bird mortalities, Migratory Bird Treaty Act compliance, nuisance animals and their control, and increasing populations of feral burros.

A total of 22 dead birds were documented on the NNSS in 2024. One was electrocuted, five were hit by vehicles, four died of entrapment, and 12 were found dead due to unknown causes. Some of these mortalities occurred during record-breaking heat and may have been caused by heat exposure.

During winter raptor surveys, only one raptor species, a red-tailed hawk (*Buteo jamaicensis*), was detected during both surveys on the southern route. Three raptor species including 19 observations of red-tailed hawks, 6 of American kestrels (*Falco sparverius*), and 2 of northern harriers (*Circus cyaneus*) were observed on the Yucca Flat route. Common ravens (*Corvus corax*) and loggerhead shrikes (*Lanius ludovicianus*) were more prevalent on the Yucca Flat route than on the southern route. Three bird survey routes patterned after United States Geological Survey (USGS) Breeding Bird Surveys (BBS) were added to our monitoring efforts for 2024. A total of 33 different bird species and 566 bird detections were recorded during the surveys. Black-throated sparrow (*Amphispiza bilineata*) was the most common species detected (~33% of all birds counted), occurring on all routes. A noteworthy observation of twelve pinyon jays (*Gymnorhinus cyanocephalus*) was observed on the North Route.

Acoustic bat monitoring continued for the fourth consecutive year as part of the North American Bat Monitoring Program, and the little brown bat (*Myotis lucifugus*) was detected for the first time on the NNSS. Feral horse distribution was similar this year to last year with concentrated activity around Camp 17 Pond and Gold Meadows Spring especially during the hot, dry summer months, and 36 individual horses were identified. A total of 70 deer were observed on two survey routes, which equates to an average of 11.7 deer per night. This is 2.6 times higher than the previous two years when 4.5 and 4.3 deer per night were observed, respectively.

Based on camera trap data, desert bighorn sheep were detected at five water sources including 700 images of at least 15 individuals at Cottonwood Spring, 326 images of at least 13 individuals at Twin Spring, 59 images of at least 13 individuals at Fortymile Canyon Tanks, 2 images of unknown sex at South Pah Canyon Tanks, and 1 image of a lamb at Delirium Canyon Tanks. Combining these observations, at least 19 sheep (6 marked ewes, 5 unmarked ewes, 1 yearling ewe, 3 lambs, 3 mature rams, 1 young ram) were documented on the NNSS during 2024.

In November 2022, NNSS biologists collaborated with Nevada Department of Wildlife to capture several sheep on and around the NNSS (e.g., Bare Mountains, Nevada Test and Training Range, Specter Range)

as part of a test and remove project to reduce the devastating impact of a disease that causes pneumonia in bighorn sheep. Three ewes (NT30, NT31, and NT32) were captured on or near the NNSS on November 11, 2022. Oral, nasal, and blood samples were taken for disease testing, radio collars were attached, and the animals were then released. None of the animals tested positive for the disease. Animals continued to be tracked during 2024 and focused their activity in Fortymile Canyon, Yucca Mountain, and the western slope of Shoshone Mountain.

A total of 393 mountain lion images (i.e., photographs or video clips) were taken during 124,741 camera hours across all sites. This equates to about 3.2 mountain lion images per 1,000 camera hours which is the highest value recorded since monitoring began in 2006. This suggests either a higher visitation rate at some of the water sources by the same individual(s) or possibly an increase in the mountain lion population. Mountain lions were detected at 11 of the 17 sites, including 9 water sources and 2 canyon sites. A minimum of four individual mountain lions (adult male, adult female, subadult male, subadult female) were known to occur on the NNSS in 2024. An additional 33,017 images of at least 75 species other than mountain lions were taken during 124,741 camera hours across all sites which is about 265 images per 1,000 camera hours. The most photographed species (40% of all images) was chukar (13,261 images at 10 of 17 sites) which is the most ever detected since camera monitoring began.

During 2024, NNSS biologists documented 101 calls regarding nuisance, injured, dead, or potentially dangerous wildlife in or around buildings, power lines, and work areas on the NNSS. Problem, injured, or dead animals included birds (42 calls), bats (15 calls), other mammals (26 calls), reptiles (16 calls), and invertebrates (2 calls). Mitigation measures taken typically involved relocating the animals away from people, instructing workers to leave the animal in place, or disposing of dead animals.

The objectives of habitat restoration and revegetation include: 1) establish a perennial vegetation community on waste cover caps to prevent water from infiltrating into buried waste through evapotranspiration, 2) establish a perennial vegetation community in disturbed areas (e.g., burned areas) to outcompete invasive annual grasses, reduce the risk of wildland fires, restore ecosystem function, and create wildlife habitat, 3) support the intent of U.S. Executive Order 13112, “Invasive Species,” (1999) to prevent the introduction and spread of non-native species and restore native species to disturbed sites, and 4) revegetation may qualify as mitigation for the loss of desert tortoise habitat under the current Opinion.

Activities conducted in 2024 included: 1) qualitative vegetation assessment at the U-3ax/bl closure cover (Corrective Action Unit [CAU] 110) (Area 3 Radioactive Waste Management Site) and West Cover and North South Cover at the 92-Acre Site (CAU 111) (Area 5 RWMC), 2) revegetating and monitoring seeding success at South Cover (CAU 111), 3) monitoring revegetation success at Cell 21 (CAU 577) and North North Cover (CAU 111) and planting transplants at Cell 21 (CAU 577), 4) monitoring revegetation success at Cells 19/20 (CAU 577, Area 5 RWMC), 5) assessing revegetation success at East and West Cover Caps (CAU 577, Area 5 RWMC), 6) assessing revegetation success and planting transplants on Cell 18 (Area 5 RWMC), 7) monitoring results from a research study to evaluate the effectiveness of different herbicide treatments to control cheatgrass after the Cherrywood Fire, 8) aerially applying herbicide over large, previously burned areas to create firebreaks in cheatgrass dominated areas and monitoring results, and 9) monitoring seeding success in revegetated area (4.5 ha) in the Area 16 Burn.

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ACRONYMS AND ABBREVIATIONS

ac	acre(s)
APP	Avian Protection Plan
ADTB	Authorized Desert Tortoise Biologist
BCS	Body Condition Score
CAU	Corrective Action Unit
cm	centimeter(s)
DOE	U.S. Department of Energy
DOE EM/NV	U.S. Department of Energy, Environmental Management Nevada Program
DOE/NV	U.S. Department of Energy, Nevada Operations Office
DTM	Desert Tortoise Monitor
EGIS	Ecological Geographic Information System
ELU	Ecological Landform Unit
EMAC	Ecological Monitoring and Compliance Program
ER	Environmental Restoration
ESA	Endangered Species Act
FWS	U.S. Fish and Wildlife Service
g	gram(s)
GOAG	desert tortoise
GPS	Global Positioning System(s)
ha	hectare(s)
kg	kilogram(s)
km	kilometer(s)
lb(s)	pound(s)
m	meter(s)
m^2	square meter(s)
mE	meters Easting
mN	meters Northing
MBTA	Migratory Bird Treaty Act
MCL	midline carapace length
mm	millimeter(s)
MOU	Memorandum of Understanding
MSTS	Mission Support and Test Services, LLC
n	sample size

NABat	North American Bat Monitoring Program
NAC	Nevada Administrative Code
NAD	North American Datum
NDNH	Nevada Division of Natural Heritage
NDOW	Nevada Department of Wildlife
NNPS	Nevada Native Plant Society
NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
NNSS	Nevada National Security Site
NOAA	National Oceanic and Atmospheric Administration
NTTR	Nevada Test and Training Range
oz	ounce(s)
PLS	pure live seed
PTT	platform transmitter terminal
R, R^2	correlation coefficient
RWMC	Radioactive Waste Management Complex
sd	standard deviation
SPP	Strategic Partnership Projects
spp.	species
ssp.	subspecies
TCS	tortoise clearance survey
UGTA	Underground Test Area
U.S.	United States
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
UTV	utility task vehicle
var.	variety
YMP	Yucca Mountain Project

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1.0 INTRODUCTION

In accordance with United States (U.S.) Department of Energy (DOE) Order DOE O 231.1B, "Environment, Safety, and Health Reporting," the Office of the Assistant Manager for Mission and Infrastructure of the DOE, National Nuclear Security Administration Nevada Field Office (NNSA/NFO) requires ecological monitoring and biological compliance support for activities and programs conducted at the Nevada National Security Site (NNSS). Mission Support and Test Services, LLC (MSTS) is the Management and Operations contractor for the NNSS. MSTS Ecological and Environmental Monitoring has implemented the Ecological Monitoring and Compliance Program (EMAC) to provide the aforementioned biological compliance support and ecological monitoring. EMAC is designed to ensure compliance with applicable laws and regulations, delineate and define NNSS ecosystems, and provide ecological information that can be used to predict and evaluate the potential impacts of proposed projects and programs on those ecosystems. During 2024, all applicable laws and regulations were followed and the permit requirements were met except for one instance of unauthorized surface disturbance (existing two-track road upgraded to a graded dirt access road) and a permit violation on the Nevada Department of Wildlife (NDOW) Scientific Collection Permit #261454. The violations were self-reported to U.S. Fish and Wildlife Service (FWS) and NDOW, respectively, and steps were taken to prevent additional violations.

This report summarizes the EMAC activities conducted by MSTS during calendar year 2024. Monitoring tasks during 2024 included six program areas: (a) biological surveys, (b) desert tortoise compliance, (c) ecosystem monitoring, (d) sensitive and protected/regulated plant monitoring, (e) sensitive and protected/regulated animal monitoring, and (f) habitat restoration implementation and monitoring. The following sections of this report describe work performed under these six program areas.

2.0 BIOLOGICAL SURVEYS

Projects or activities involving land-disturbing activities on the NNSS are reviewed by biologists to determine if 1) sensitive and protected/regulated species occur within the project area, 2) a biological survey is required to identify sensitive and protected/regulated species within the project area, and/or 3) develop mitigation measures to protect impacted species, if required. Projects submit a scope of work for review prior to start of work through several different company processes including but not limited to; National Environmental Policy Act checklists, Real Estate Operations Permits (parcels of land with specified activities or facilities designated to remain within that parcel), and/or MSTS documents.

Biological surveys are performed at project sites where land-disturbing activities are proposed. The goal is to minimize adverse effects of land disturbance on sensitive and protected/regulated plant and animal species (Table 2-1), their associated habitat, and other important biological resources. Sensitive species, as opposed to protected/regulated species, are defined as species that are at risk of extinction or serious decline or whose long-term viability has been identified as a concern but are not protected by law. They include species on the Nevada Division of Natural Heritage (NDNH) At-Risk Plant and Animal Tracking List (NDNH 2025). Protected/regulated species are those that are protected or regulated by federal or state law. Many species are both sensitive and protected/regulated (Table 2-1). Important biological resources include habitat, cover sites, nest or burrow sites, roost sites, or water sources important to sensitive species. Survey reports document species, track resources found, and provide mitigation requirements and recommendations.

2.1 Sites Surveyed and Sensitive and Protected/Regulated Species Observed

In 2024, biological surveys were conducted for 22 projects on the NNSS (Figure 2-1, Table 2-2). Several projects had multiple survey locations. Post-activity surveys, which ensure the project adhered to mitigation requirements, were conducted for projects completed prior to 2024, as well as projects completed during 2024 (Figure 2-1, Table 2-2). Biologists surveyed a total of 113.1 hectares (ha) for the projects (Table 2-2). The surveyed area included the project area and a buffer area extending 10-20 meters (m) beyond the project area. Projects disturbed a total of 27.0 ha of undisturbed land (Table 2-2). Notably found during surveying was a human-constructed deep hole in the ground in desert tortoise (*Gopherus agassizii*) habitat that could entrap wildlife. The hole was filled in during project 24-07. Sensitive and protected/regulated plant and animal species and important biological resources found during the surveys included: five desert tortoise burrows (avoided or collapsed), five inactive bird nests (avoided or removed), one inactive owl nest (avoided), one inactive red-tailed hawk (*Buteo jamaicensis*) nest (removed); relocation of five horned lizards (*Phrynosoma platyrhinos*); 24 chukar (*Alectoris chukar*); ungulate sign (pronghorn antelope [*Antilocapra americana*], feral burro [*Equus asinus*], and mule deer [*Odocoileus hemionus*]); one invasive plant at multiple locations (Sahara mustard [*Brassica tournefortii*]); Monarch butterfly (*Danaus plexippus*) habitat (milkweed [*Asclepias erosa*]); yucca plants (Joshua tree [*Yucca brevifolia*] and Mojave yucca [*Yucca schidigera*]); and multiple cactus species (see Table 2-2 for resources listed by project). Scientists communicated with project personnel and provided written summary reports to project managers of survey findings and mitigation recommendations when applicable.

2.2 Potential Habitat Disturbance

Biological surveys are conducted for all activities that have the potential to disturb habitat. These surveys are required in undisturbed habitat, whenever vegetation has re-colonized old disturbances, and/or sensitive or protected/regulated species may occur in the area. For example, tortoises may move through

Table 2-1. List of sensitive and protected/regulated species known to occur on the NNSS.

Plant Species	Common Names	Status[a]
Moss Species		
Entosthodon planoconvexus	Planoconvex cordmoss	S, H
Flowering Plant Species		
Arctomecon merriamii	White bearpoppy	S, M
Astragalus beatleyae	Beatley's milkvetch	S, H
Astragalus funereus	Black woollypod	S, H
Astragalus oophorus var. *clokeyanus*	Clokey eggvetch	S, W
Chylismia megalantha	Cane Spring suncup	S, M
Cryptantha clokeyi	Clokey's cryptantha	S, E
Cymopterus ripleyi var. *saniculoides*	Sanicle biscuitroot	S, W
Eriogonum concinnum	Darin buckwheat	S, M
Eriogonum heermannii var. *clokeyi*	Clokey buckwheat	S, W
Frasera pahutensis	Pahute green gentian	S, M
Galium hilendiae ssp. *kingstonense*	Kingston Mountains bedstraw	S, H
Hulsea vestita ssp. *inyoensis*	Inyo hulsea	S, W
Ivesia arizonica var. *saxosa*	Rock purpusia	S, H
Penstemon fruticiformis ssp. *amargosae*	Death Valley beardtongue	S, M
Penstemon pahutensis	Pahute Mesa beardtongue	S, W
Penstemon palmeri var. *macranthus*	Lahontan beardtongue	S, E
Phacelia beatleyae	Beatley scorpionflower	S, M
Phacelia filiae	Clarke phacelia	S, W
Phacelia mustelina	Weasel phacelia	S, W
Agavaceae	Yucca (3 species), Agave (1 species)	CY
Cactaceae	Cacti (17 species)	CY
Juniperus osteosperma	Utah juniper	CY
Pinus monophylla	Single-leaf pinyon	CY

Table 2-1. List of sensitive and protected/regulated species known to occur on the NNSS (continued).

Animal Species	Common Name	Status[a]
Mollusk Species		
Pyrgulopsis turbatrix	Southwest Nevada pyrg	S, A
Beetle Species		
Miloderes mercuryensis	Mercury weevil	S, A
Butterfly Species		
Danaus plexippus	Monarch butterfly	S, A
Reptile Species		
Plestiodon gilberti rubricaudatus	Western red-tailed skink	S, IA
Gopherus agassizii	Desert tortoise	LT, S, NPT, A
Bird Species[b]		
Astur atricapillus	American goshawk	S, NPS, A
Alectoris chukar	Chukar	G, IA
Aquila chrysaetos	Golden eagle	EA, NPS, A
Artemisiospiza nevadensis	Sagebrush sparrow	S, NPS. A
Asio flammeus	Short-eared owl	S, NPS, A
Asio otus	Long-eared owl	S, NP, A
Callipepla gambelii	Gambel's quail	G, IA
Coccyzus americanus	Western yellow-billed cuckoo	LT, S, NPT, IA
Corvus brachyrhynchos	American crow	G, IA
Falco peregrinus	Peregrine falcon	S, NPS, A
Gymnorhinus cyanocephalus	Pinyon jay	S, NP, IA
Haliaeetus leucocephalus	Bald eagle	EA, S, NPS, A
Ixobrychus exillis	Least bittern	S, NP, IA
Lanius ludovicianus	Loggerhead shrike	NPS, A
Melanerpes lewis	Lewis's woodpecker	S, NP, IA
Oreoscoptes montanus	Sage thrasher	NPS, IA
Riparia riparia	Bank swallow	S, NP, IA
Spinus pinus	Pine siskin	S, NP, IA
Spizella breweri	Brewer's sparrow	NPS, IA
Toxostoma lecontei	LeConte's thrasher	S, NP, IA

Table 2-1. List of sensitive and protected/regulated species known to occur on the NNSS (continued).

Animal Species	Common Name	Status[a]
Mammal Species		
Antilocapra americana	Pronghorn antelope	G, A
Antrozous pallidus	Pallid bat	NP, A
Cervus elaphus nelsoni	Rocky Mountain elk	G, IA
Corynorhinus townsendii	Townsend's big-eared bat	S, NP, A
Equus asinus	Burro	H&B, A
Eptesicus fuscus	Big brown bat	NP, A
Equus caballus	Horse	H&B, A
Euderma maculatum	Spotted bat	S, NP, A
Lasionycteris noctivagans	Silver-haired bat	S, NP, A
Lasiurus frantzii	Western red bat	S, NP, A
Lasiurus cinereus	Hoary bat	S, NP, A
Lynx rufus	Bobcat	F, IA
Microdipodops megacephalus	Dark kangaroo mouse	NPS, IA
Microdipodops pallidus	Pale kangaroo mouse	S, NPS, IA
Myotis californicus	California myotis	NP, A
Myotis ciliolabrum	Western small-footed myotis	NP, A
Myotis evotis	Long-eared myotis	NP, A
Myotis lucifugus	Little brown bat	S, NP, A
Myotis thysanodes	Fringed myotis	S, NP, A
Myotis volans	Long-legged myotis	NP, A
Myotis yumanensis	Yuma myotis	NP, A
Ovis canadensis nelsoni	Desert bighorn sheep	G, A
Odocoileus hemionus	Mule deer	G, A
Parastrellus hesperus	Canyon bat	NP, A
Puma concolor	Mountain lion	G, A
Sorex tenellus	Inyo shrew	S, IA
Sylvilagus audubonii	Desert cottontail	G, IA
Sylvilagus nuttallii	Nuttall's cottontail	G, IA
Tadarida brasiliensis	Brazilian free-tailed bat	NP, A
Urocyon cinereoargenteus	Gray fox	F, IA

Table 2-1. List of sensitive and protected/regulated species known to occur on the NNSS (continued).

Animal Species	Common Name	Status
Vulpes macrotis	Kit fox	F, IA

[a] **Status Codes for Column 3**

Endangered Species Act, U.S. Fish and Wildlife Service
- LT — Listed Threatened

U.S. Department of Interior
- H&B — Protected under *Wild Free Roaming Horses and Burros Act*
- EA — Protected under *Bald and Golden Eagle Act*

State of Nevada – Animals
- S — Nevada Division of Natural Heritage (NDNH) – At-Risk Plant and Animal Tracking List
- NPT — Nevada Protected-Threatened, species protected under Nevada Administrative Code (NAC) 503
- NPS — Nevada Protected-Sensitive, species protected under NAC 503
- NP — Nevada Protected, species protected under NAC 503
- G — Regulated as game species under NAC 503
- F — Regulated as fur bearer species under NAC 503

State of Nevada – Plants
- S — NDNH – At-Risk Plant and Animal Tracking List
- CY — Protected as a cactus, yucca, or Christmas tree from unauthorized collection on public lands under NAC 527

NNSS Sensitive Plant Ranking
- H — High (high potential for NNSS populations to become at-risk in the future and/or is limited in range)
- M — Moderate (moderate potential for NNSS populations to become at-risk in the future)
- W — Watch (low potential for NNSS populations to become at-risk in the future)
- E — Evaluate (status unknown)

Long-term Animal Monitoring Status for the NNSS
- A — Active
- IA — Inactive

[b] All bird species on the NNSS are protected by the *Migratory Bird Treaty Act* except for chukar (*Alectoris chukar*), Gambel's quail (*Callipepla gambelii*), English house sparrow (*Passer domesticus*), Rock dove (*Columba livia*), Eurasian collared dove (*Streptopelia decaocto*), and European starling (*Sturnus vulgaris*). Most bird species are also protected under NAC 503.

Sources used: NDNH 2025, NAC 2025a, FWS 2025

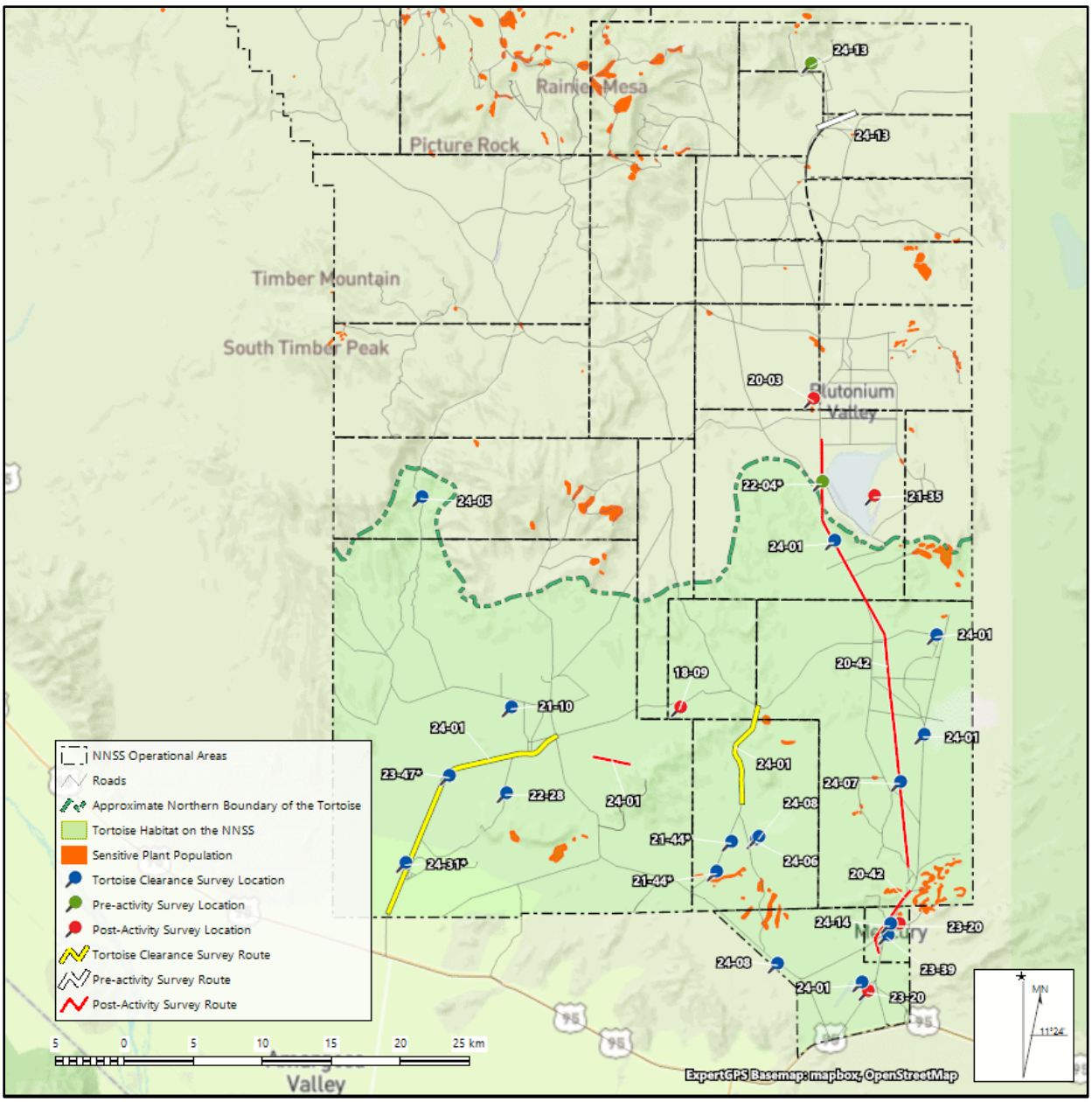

Figure 2-1. Biological surveys conducted in 2024. Projects with an asterisk (*) also had a post-activity survey completed in 2024.

project areas and may be concealed under vegetation during activities where heavy equipment is used. Western burrowing owls frequently inhabit burrows, buried pipes with exposed openings, and culverts at disturbed sites. Biological surveys are completed to ensure sensitive or protected/regulated animal and plant species are not in harm's way.

Depending on the potential for sensitive and protected/regulated species to be within a project area, biologists conduct appropriate surveys for each land-disturbing activity prior to project start. A tortoise clearance survey (TCS) is required within 24 hours of the start of a project when there is a possibility that a tortoise may be in the project area, adjacent land, or wander into the project area during construction activities. A pre-activity survey is completed by walking meandering transects of the entire area and is required when there is no possibility of a tortoise being encountered during the project's activities, but

other sensitive and protected/regulated species may be encountered. A pre-activity survey for buildings is required prior to demolition of buildings, reactivation of decommissioned buildings, or relocation of trailers. The pre-activity survey for buildings also includes a survey of the outside of the building and the entire construction area. A pre-activity exit survey for tunnels or structures that may be used by bats is required prior to reactivation of deactivated tunnels or structures. A post-activity survey is required for certain projects to determine the total amount of habitat disturbed and ensure the project followed all applicable biological compliance. Table 2-2 lists the type of surveys required for each project.

During vegetation mapping surveys of the NNSS, delineated areas of homogeneous plant communities were identified and referred to as Ecological Landform Units (ELUs) (Ostler et al. 2000). These ELUs were evaluated for importance with the intent that comparable ELUs would respond similarly to land management practices. This concept was later applied to categorizing groupings of ELUs into important habitat types as follow: *Pristine Habitat* (having few human-made disturbances), *Unique Habitat* (containing uncommon biological resources such as a natural wetland), *Sensitive Habitat* (containing vegetation associations that recover very slowly from direct disturbance or are susceptible to erosion), and *Diverse Habitat* (having high plant species diversity).

Projects in 2024 disturbed a total of 27.0 ha of undisturbed land (Table 2-2). Projects utilize previously disturbed areas as well as existing roads as much as possible to minimize the disturbance of habitat. Projects 18-09, 20-42, 21-44, and 23-47 disturbed 9.1 ha of *Sensitive Habitat*. Project 20-42 disturbed 0.5 ha of *Diverse* habitat, 0.8 ha of *Unique* habitat, and 0.9 ha of *Sensitive* and *Unique* habitat. The total area disturbed (ha) of important habitat types tracked since 1999 comprises 11.01 (*Pristine*), 25.92 (*Unique*), 431.29 (*Sensitive*), and 87.55 (*Diverse*).

Table 2-2. Summary of biological surveys conducted on the NNSS during 2024; TCS = tortoise clearance survey; DTM = desert tortoise monitor.

Project No.	Project Name	Important Species/Resources Found	Area Surveyed (ha)	Project area in Undisturbed Habitat (ha)	Mitigation in 2024
18-09	Test Bed South	None	NA [a]	2.7	Post-activity Survey
20-01	RWMC Westward Expansion	None	1.7	0	TCS
20-03	U1a Modernization Sewage Lagoon	None	NA [a]	0	Post-activity Survey
20-42	138 kV Power Transmission System Replacement	Reported in 2024	NA [a]	16.0	Post-activity Survey
21-10	Corrective Action Unit 114	Red-tailed hawk and nest, tortoise burrow (collapsed)	1.8	0	TCS, DTM
21-25	Corrective Action Unit 572	Red-tailed hawk	0	0	Pre-activity Survey for Buildings
21-35	Desert Eagle Road Grading	None	NA [a]	2.5	Post-activity Survey
21-44	Rock Valley Direct Comparison	Several horned lizards (relocated), 2 predator burrows (collapsed)	6.2	2.4	Formal Consultation, TCS, DTM, Post-activity Survey
22-04	Fire Station 2 Waterline	Yucca, cacti, inactive bird nest, ungulate sign	13.4	2.2	Pre-activity Survey, Post-activity Survey
22-28	Rock Valley Seismic Station Reoccupation	Cacti, ungulate sign, 2 tortoise burrows (avoided), 2 predator burrows (avoided)	3.1	0	TCS, DTM
23-20	Flow Meter Installation on Water Systems	None	NA [a]	0	Post-activity Survey
23-39	Fiscal Year 2024 Demolition	2 dead bats on glue traps, 4 inactive bird nests (removed)	0	0	Pre-activity Survey for Buildings
23-47	Research and Sounding Rocket Test 2	Cacti, ungulate sign	2.3	0.4	TCS, DTM
24-01	Roads and Grounds Maintenance Activities 2024	Yucca, cacti, ungulate sign, Sahara mustard (invasive plant)	66.2	0.8	TCS, Pre-activity Survey, DTM, Post-activity Survey
24-05	Canyon to Stockade Power Pole Repairs	Ungulate sign, milkweed (Monarch butterfly habitat), chukar	1.9	0	TCS, DTM
24-06	Rock Valley Ground Control Points	Yucca, cacti	1.5	0	TCS, DTM
24-07	Trailer Removal 23-562A	Small pitfall with potential to entrap animals (backfilled)	0.6	0	TCS
24-08	Gradiometer Seismic Arrays	Yucca, cacti, 2 tortoise burrows (avoided)	1.9	0	TCS, DTM
24-13	Climax Stock Mine Site Support	Inactive owl nest	0.8	0	Pre-activity Survey

Table 2-2. Summary of biological surveys conducted on the NNSS during 2024; TCS = tortoise clearance survey; DTM = desert tortoise monitor (continued).

Project No.	Project Name	Important Species/Resources Found	Area Surveyed (ha)	Project area in Undisturbed Habitat (ha)	Mitigation in 2024
24-14	Mercury Concrete Pads	Cacti	2.0	0	TCS
24-31	Power Poles MX Racetrack	Ungulate sign, Sahara mustard (invasive plant)	1.6	0	TCS, Post-activity Survey
24-32	Gate 700 Substation Upgrades	Yucca, cacti, ungulate sign	8.1	0	Pre-activity Survey
		Total	**113.1**	**27.0**	

[a] Post-activity survey completed in 2024. Area surveyed during TCS or pre-activity survey was reported in previous years' EMAC reports.

3.0 DESERT TORTOISE COMPLIANCE

Tortoises occur within the southern one-third of the NNSS. This species is listed as threatened under the Endangered Species Act (ESA). In December 1995, NNSA/NFO completed consultation with the FWS concerning the effects of NNSA/NFO activities, as described in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV 1996), on the tortoise. NNSA/NFO received a Biological Opinion from FWS in August 1996 (FWS 1996). On July 2, 2008, NNSA/NFO provided FWS with a Biological Assessment of anticipated activities on the NNSS from 2009 through 2019. NNSA/NFO received the Programmatic Biological Opinion on February 12, 2009 (FWS 2009). On February 27, 2019, NNSA/NFO provided FWS with a Biological Assessment of anticipated activities on the NNSS from 2019 through 2029 and entered into formal consultation with FWS to obtain a new Biological Opinion. NNSA/NFO received the Programmatic Biological Opinion (herein referred to as Opinion) on August 27, 2019 (FWS 2019).

The Desert Tortoise Compliance task of EMAC implements the protective measures of the Opinion, documents compliance actions taken by NNSA/NFO, and assists NNSA/NFO in FWS consultations. All protective measures listed in the Opinion were implemented by biologists in 2024, including (a) conducting one-hundred percent coverage TCSs at project sites within 24 hours from the start of project construction, (b) ensuring projects have a trained desert tortoise monitor (DTM) on site during site clearing and heavy equipment operation, (c) developing effects analysis for proposed disturbances to append to the Opinion, and (d) preparing an annual compliance report for NNSA/NFO submittal to FWS.

3.1 Project Surveys and Compliance Documentation

Eighteen projects occurring within the range of the tortoise were reviewed by biologists in 2024 and 12 projects in progress were carried over from previous years (Table 3-1). Projects are placed in one of three categories based on biological review: framework programmatic action (requires surveys and formal consultation with FWS), program-level action (requires surveys but no consultation with FWS), or no effects to the tortoise (surveys may still be required based on other important species in the project area). Once placed in one of the categories, required compliance activities are determined and completed (Table 3-1).

TCSs were completed for 12 projects in 2024, with some projects having multiple survey locations (Figure 2-1, Table 3-1). No tortoises were observed, reported injured, or reported killed during projects. Projects disturbed a total of 22.3 ha of tortoise habitat during 2024. One project, 24-01, upgraded an existing two-track road to a graded dirt access road without requesting a TCS. The area was surveyed after grading with heavy equipment was completed. The project disturbed 0.8 ha of habitat with no other observed impacts to the tortoise (e.g., no carcasses or collapsed burrows). Noncompliance was addressed with all parties involved and reported in the annual report to FWS.

In January 2025, the annual report summarizing tortoise compliance activities conducted on the NNSS from January 1 through December 31, 2024, was submitted to FWS. This report, required under the Opinion, contains (a) the location and size of land disturbances that occurred within the range of the tortoise; (b) the number of tortoises injured, killed, or relocated off project sites; (c) a map showing the location of all tortoises sighted or relocated from on or near roads as well as vehicular mortalities; and (d) a summary of construction mitigation and monitoring efforts.

Table 3-1. Summary of projects within the range of the tortoise that were reviewed, compliance activities required, surveys completed, and amount of tortoise habitat disturbed in 2024; TCS = tortoise clearance survey, DTM = desert tortoise monitor.

Project No.	Project Name	Description of Compliance Activity Required	TCS Completed in 2024	Tortoise Habitat Disturbed in 2024 (ha)
17-12 (18-43) [a]	Power Pole Weed Abatement	Formal Consultation, TCS, DTM		0
18-05 [a]	RWMC Expansion	Formal Consultation, TCS, DTM		0
18-09 [a]	Test Bed South	Formal Consultation, TCS, DTM		2.7
19-16 [a]	Area 6 Tippipah Batch Plant	Formal Consultation, TCS, DTM		0
20-01 [a]	RWMC Westward Expansion	Formal Consultation, TCS, DTM		0
20-42 [a]	138 kilovolt Power Transmission System Replacement	Formal Consultation, TCS, DTM		16.0
21-10 [a]	Corrective Action Unit 114	TCS, DTM	✓	0
21-25 [a]	Correction Action Unit 572	TCS, DTM		0
21-44 [a]	Rock Valley Direct Comparison	Formal Consultation, TCS, DTM	✓	2.4
21-46 [a]	Device Assembly Facility Surface Modernization	Formal Consultation, TCS, DTM		0
22-28 [a]	Rock Valley Seismic Station Reoccupation	TCS, DTM	✓	0
23-20 [a]	Flow Meter Installation on Water Systems	TCS		0
23-39	Fiscal Year 2024 Demolition	TCS	✓	0
23-47	Research and Sounding Rocket Test	TCS, DTM	✓	0.4
24-01	Roads and Grounds Maintenance Activities 2024	TCS, DTM	✓	0.8
24-02	Rock Valley 100-meter Array	No effects to the tortoise		0
24-05	Canyon to Stockade Power Pole Repairs	TCS, DTM	✓	0
24-06	Rock Valley Ground Control Points	TCS, DTM	✓	0
24-07	Trailer Removal 23-562A	TCS	✓	0
24-08	Gradiometer Seismic Array	TCS, DTM	✓	0
24-11	Test Bed March Venture	No effects to the tortoise		0

[a] Project carried over from previous year.

Table 3-1. Summary of projects within the range of the tortoise that were reviewed, compliance activities required, surveys completed, and amount of tortoise habitat disturbed in 2024; TCS = tortoise clearance survey, DTM = desert tortoise monitor (continued).

Project No.	Project Name	Description of Compliance Activity Required	Survey Completed in 2024	Tortoise Habitat Disturbed in 2024 (ha)
24-12	138 kilovolt Powerline Ceremony	No effects to the tortoise		0
24-14	Mercury Concrete Pads	TCS	✓	0
24-17	Crater Crawl	No effects to the tortoise		0
24-23	Training Academy X Container	No effects to the tortoise		0
24-24	23-460 Electric Vehicle Charging Stations	No effects to the tortoise		0
24-25	Rock Valley Geophones	No effects to the tortoise		0
24-31	Power Poles MX Racetrack	TCS	✓	0
24-33	Area 27 Ground Rods	No effects to the tortoise		0
24-38	Area 5 Electric Vehicle Charging Stations and Paving	No effects to the tortoise		0

Compliance with the Opinion ensures the tortoise is protected on the NNSS and the cumulative impacts on this species are minimized. In the Opinion, FWS determined the "incidental take" ("take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct, and "incidental take" is a take that results from activities that are otherwise lawful) of tortoises on the NNSS and the cumulative acreage of tortoise habitat disturbed on the NNSS are parameters that should be measured and monitored annually. Although all detected incidental take events are reported under the Opinion, parameters set by FWS in 2019 require only large tortoises (>180 millimeters [mm] midline carapace length [MCL]) be reported under the Opinion's incidental take limits. This is due to the low detection rate of small tortoises. Cumulative totals under the current Opinion reported in the FWS annual report are presented in Table 3-2. Cumulative totals of all age classes tracked since 1992 are presented in Table 3-3.

There were 40 reported tortoise roadside observations in 2024. There was no reported roadkill. There were 2 small and 38 large tortoises observed on roads. The two small tortoises were safely moved off the road. Of the 38 large tortoises, 3 did not need to be handled and 4 were moved off the road twice in one day. When a tortoise is confirmed to be moved off a road multiple times in one day, incidental take of that animal is counted once. Thirty-one large tortoises were determined to be incidental take (Figure 3-1).

Some of the tortoises observed were previously tagged with unique numbers and identified multiple times: NNSS20 three times, NNSS21 seven times, and NNSS66 one time. Four tortoises on roads were paper-tagged with new unique numbers this year by an Authorized Desert Tortoise Biologist (ADTB). Three of these had multiple sightings: NNSS71 two times, NNSS74 two times, and NNSS75 two times.

Table 3-2. Summary of tortoise habitat disturbance, tortoise habitat disturbance limits, incidental take of large tortoises (>180 mm MCL), and incidental take limits of large tortoises under the current Opinion August 27, 2019 – December 31, 2024.

Program	Actual No. of Hectares Impacted (Limit Allowed)	No. of Tortoises Incidentally Taken (Maximum Allowed)	
		Non-injury or Non-mortality [a]	Detected Injury or Mortality
1) Continued Use of Existing Roads	NA	222 (350) [b]	4 (15) [c]
2) Defense	0.3 (202)	0 (10)	0 (2)
3) Waste Management	21.3 (101)	0 (10)	0 (2)
4) Environmental Restoration	0 (101)	0 (10)	0 (2)
5) Nondefense Research and Development	14.8 (405)	0 (20)	0 (4)
6) Work-for-Others	0 (202)	0 (20)	0 (2)
7) Infrastructure	51.1 (202)	2 (20)	0 (4) [d]
Totals	**87.5 (1,213)**	**224 (440)**	**4 (31)**

[a] All tortoises observed in harm's way may be moved to a safe location as outline in the Opinion.
[b] No more than 35 non-injury or non-mortality tortoises in a given year and no more than 350 during the term of the Opinion.
[c] No more than 4 tortoises killed in a given year and no more than 15 killed during the term of the Opinion.
[d] No more than 2 tortoises killed in a given year and no more than 4 killed during the term of the Opinion.

3.1.1 Mitigation for Loss of Tortoise Habitat

Prior to land-disturbing activities associated with any projects of the Strategic Partnership Projects (SPP) program (formerly Work-for-Others), the proponent shall pay remuneration fees to minimize effects from disturbance of tortoise habitat on the NNSS in accordance with FWS-approved instructions (FWS 2019). For land-disturbing activities that occur under all other programs (i.e., Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Infrastructure), NNSA/NFO will minimize effects from disturbance of tortoise habitat by funding and implementing FWS-approved conservation actions on the NNSS (FWS 2019). Remuneration fees are currently paid into the Mojave Desert Tortoise Sub-Account through the National Fish and Wildlife Foundation Chief Financial Officer for all SPP activities at the rate of $1,103 per acre (ac) of disturbance. All other programs can utilize the NNSS's accrued funds from implementation of FWS-approved conservation studies. Deductions from the accrued funds are applied at a level equal to the rate of $1,103 per ac of disturbance.

Table 3-3. Summary of disturbance of tortoise habitat, tortoises observed along roads, tortoises moved off roads, and tortoises killed or injured by vehicles on roads for all size classes (small and large) from 1992–2024.

Calendar Year	Hectares Disturbed	Total Roadside Observations	Tortoises Moved off Roads	Killed or Injured by Vehicles
1992-1996	57.4	Not documented	Not documented	2
1997	0.0	12	0	0
1998	0.0	3	3	1
1999	11.6	7	4	0
2000	2.5	7	7	0
2001	8.9	11	11	1
2002	6.3	3	3	0
2003	1.5	12	12	0
2004	9.1	17	17	3
2005	16.2	14	14	1
2006	5.5	35	14	1
2007	5.5	34	17	1
2008	2.6	19	19	0
2009	3.3	31	5	1
2010	1.8	22	13	2
2011	1.9	13	9	1
2012	6.2	19	18	1
2013	4.8	12	14	2
2014	2.2	16	17	0
2015	0.0	26	17	2
2016	0.1	35	19	1
2017	0.5	45	41	2
2018	6.0	34	31	0
2019	0.0	66	56	2
2020	9.9	38	32	2
2021	22.1	38	30	2
2022	11.4	110	93	5
2023	21.8	92	73	3
2024	22.3	40	33	0
Total	**238.6**	**811**	**622**	**36**

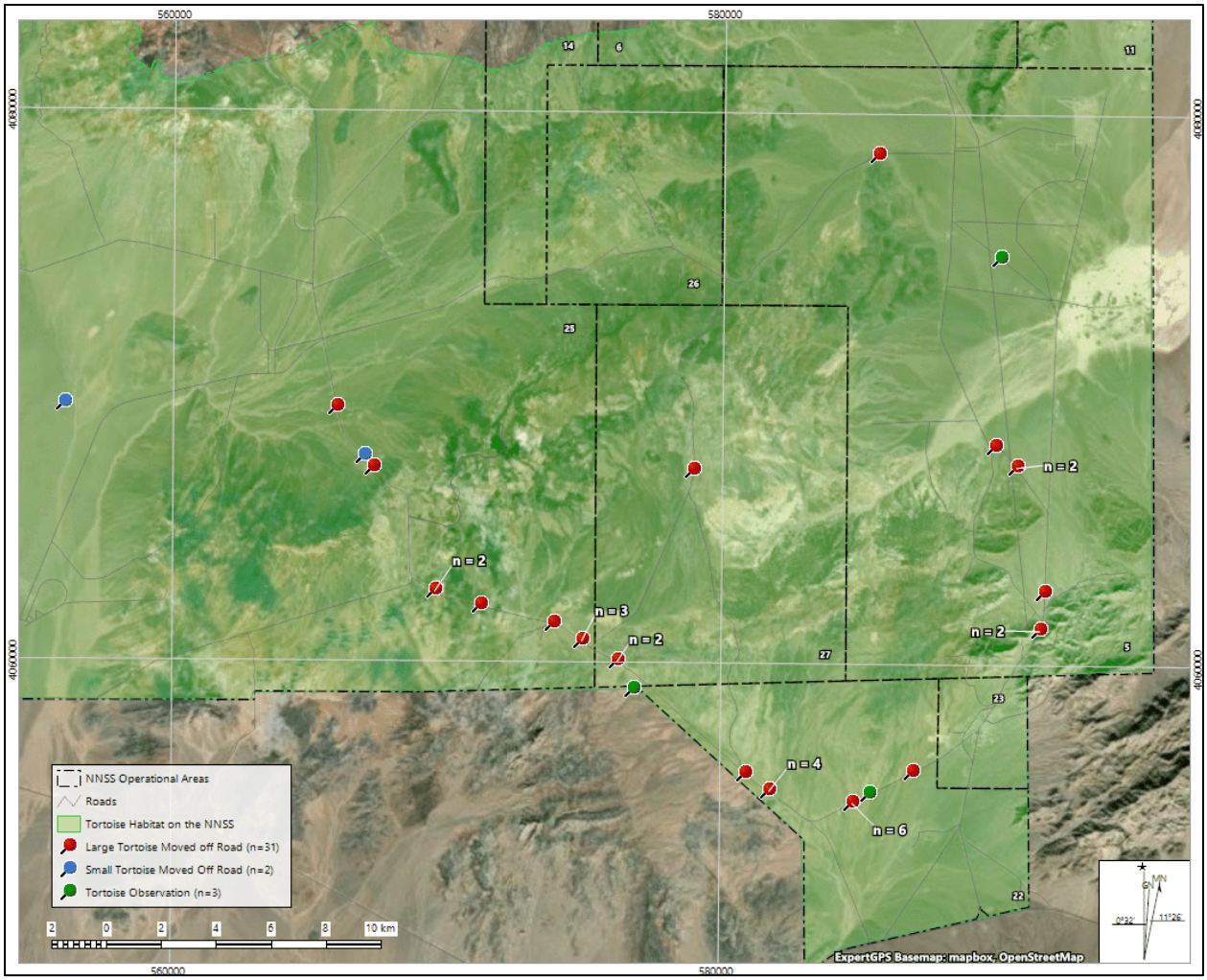

Figure 3-1. Locations of tortoise roadside observations on the NNSS (n=40) with associated size classes (large tortoises are >180 mm MCL and small are ≤180 mm MCL) from January 1 through December 31, 2024. Coordinates in UTM NAD83 (Zone 11, meters).

Five projects disturbed tortoise habitat in 2024. Two of the projects were framework programmatic actions which prepaid remuneration fees in previous years: 18-06 disturbed 6.7 ac and 20-42 disturbed 39.5 ac. Framework programmatic action 21-44 was appended to the Opinion in 2022 but proposed a change in scope of work and entered re-initiation of consultation in 2024. The appended consultation was approved May 21, 2024, by FWS. The number of acres affected by the project increased from 25 to 46 with the change in scope of work. A deduction of $23,163 (21 ac x $1,103) was made to accrued funds for the additional 21 ac added to the scope of work. The project disturbed 5.9 ac of habitat in 2024.

The remaining two projects were program-level actions, 23-47 and 24-01, which paid remuneration fees through a deduction from accrued funds:

- 23-47 disturbed 1.1 ac; therefore, fees cost $1,213 (1.1 ac x $1,103)
- 24-01 disturbed 2.0 ac; therefore, fees cost $2,206 (2.0 ac x $1,103)

3.2 Conservation Recommendations

Biologists continue to conduct research and increase tortoise conservation awareness through several MSTS-implemented activities and FWS conservation recommendations.

3.2.1 Radiological Exposure Study

As a recommendation from FWS, biologists implemented a study in 2019 of tortoise exposure to radiological sources or fallout from nuclear testing by opportunistically testing tortoise carcasses for radionuclides. Tortoise carcasses that are found on the NNSS, mainly roadkill, are sent to a lab to test for radionuclides. The study began in 2019 with two roadkill carcasses approved by FWS to be processed and tested. The only human-made radionuclide detected was Strontium-90. This is a calcium analog that accumulates in bone. It is a fission product that can be measured around the world due to global fallout from past atmospheric weapons testing. The concentrations were detectable but very low and would not result in a dose exceeding limits set by the DOE to protect biota.

A total of 18 tortoises collected from various mortalities, June 2019-May 2023, were processed in 2024. Three control carcasses obtained from Joshua Tree National Park were not tested this year. Where possible, the tortoises were separated into soft tissue and bone/keratin (shell). Samples were submitted for Strontium-90, Plutonium-239 and 240, Americium-241, Uranium, and gamma spectrometry analysis. Radionuclide results are published in Chapter 8 of the NNSS's 2023 Environmental Report (https://nnss.gov/publication-library/environmental-publications/). Bone and shell from the tortoises, particularly the tortoise hit and killed by a vehicle in Area 12 in 2023, had the highest concentrations of Strontium-90. This may not be unusual as strontium is an analog of calcium, so it accumulates in bone. Uranium detected in the tortoise samples could not be distinguished from natural uranium based on isotopic ratios. Radionuclide concentrations were below levels considered harmful to the health of animals.

3.2.2 Road Study

The direct and indirect effects roads have on tortoises have been implicated in population declines. The effects that linear habitat disturbances have on the tortoise extend beyond the footprint of the actual road. The Road Study, approved by FWS and conducted from 2012-2018, focused on increasing understanding of tortoise activity near unfenced, moderately trafficked roads (<25 to >600 vehicles/day) within the northern range of the tortoise. Thirty tortoises were captured on or near paved roads and monitored each for three active seasons using Global Position System (GPS) loggers and radio telemetry. The study examined habitat use, home range, speed, activity, road-crossings, and movement behavior. Biologists collaborated with the Smithsonian Conservation Biology Institute for the study analysis. A technical report was published by Perry et al. (2023) on February 2, 2023, describing results from the study.

Work continued on studying impacts of roads through an opportunistic mark-recapture study that allows tracking of road crossing events for individual tortoises. The study was approved by FWS and allows ADTBs to attach identification numbers to tortoises when they are found and moved safely off roads. The objectives of the study are to (1) determine if tortoises moved safely off roads are repeat offenders, (2) identify trends in repeat offenders crossing roads, and (3) assist with collection of tortoise density data. Marking tortoises found on roads for future identification will provide information on population size and trends over time, which will assist in future conservation and management efforts (Pike et al. 2005). Four tortoises were marked with unique numbers this year: NNSS71, NNSS74, NNSS75, and NNSS76. Fifteen tortoises have been given unique numbers from 2020-2024, with one known to have been hit and killed by a vehicle in 2022 (NNSS64). Having the ability to identify tortoises on roadways based on their

identification number has been valuable in identifying the number of tortoises living along roadways and incidental take.

In response to the high roadkill numbers in 2022, biologists continue to increase employee outreach. This year biologists set up information tables during safety fairs at the Area 5 Radioactive Waste Management Complex (RWMC), Area 12 P-tunnel, Area 23 Mercury, and Area 27 JASPER/Baker. Information was handed out on what to do when encountering a tortoise on the NNSS. Employees that answered questions on tortoise conservation received prizes. Biologists also became involved in new hire orientation, providing the new hire presentations throughout the year that includes tortoise conservation awareness training.

As in previous years, biologists continued placing temporary warning signs on either side of the road where multiple tortoise observations occur. These are locations where particular tortoises are observed daily, foraging along the road edges or crossing the road. Signs are left out for several weeks or until observations stop. All nets radio announcements are made when weather conditions are anticipated to increase tortoise activity. Biologists also post blogs on the company's webpage on tortoise emergence from hibernation and roadkill events.

3.2.3 Juvenile Translocation Study

In September 2012, 60 captive juvenile tortoises were translocated from the Desert Tortoise Conservation Center in Las Vegas to the southern edge of the NNSS in Area 22 to evaluate the survival of juvenile tortoises released in the wild. The NNSS provides one of the largest protected habitat areas in Southern Nevada. The project is part of a long-term collaborative effort involving FWS, MSTS, and the San Diego Zoo Global (formerly the Institute for Conservation Research). Few studies have investigated translocated juvenile tortoise survival, so data obtained from this study will be valuable to assess translocation as a possible means of tortoise recovery.

Each tortoise was affixed with a very high frequency transmitter prior to release for post-release monitoring purposes. Regular monitoring of the animals occurred post-release from 2012 through 2023. Regular monitoring was conducted during 2024—once a month in January, February, and December; weekly in March, April, May, September, and October; and twice a month in June, July, August, and November. Additional monitoring was conducted in early January 2025 to determine each tortoise's winter burrow. Once a tortoise was located, information such as date and time, elevation, Universal Transverse Mercator (UTM) coordinates North American Datum 1983 (NAD83), position (i.e., in burrow and burrow number, under vegetation, in the open), habitat, substrate, activity, foraging evidence and species, temperature, cloud cover, and wind were recorded.

At the beginning of 2024, 10 tortoises were known to be alive (Table 3-4; Figure 3-2). By the end of 2024, 10 of the 60 tortoises (16.7%) (4 female, 6 male) were still alive. Our survival rate of 16.7% after 12 years is a little higher but comparable to an estimated 15.0% (9 of 60 alive) survival based on an annual survival rate of 85.7% calculated for a natural population (Turner et al. 1987). Excluding the four missing males (4003, 4040, 4041, 4048) and one missing female (4046) there is a higher survival rate, albeit not as high as previous years, for males (22.2% [6 of 27]) compared to females (13.8% [4 of 29]) with most of the mortalities (34 of 45; 76%) caused by suspected coyote (*Canis latrans*) and kit fox (*Vulpes macrotis*) predation. Given the importance of females surviving to adulthood to reproduce, this may be a critical life stage for females. If female juveniles are not surviving to sexual maturity, this could contribute to a decline in tortoise populations. Mulder et al. (2017) found that adult female fitness and integration following translocation was high which suggests that survival, integration, and acceptance of translocated female tortoises into a natural population may be key to a successful translocation. The more females, resident or translocated, that survive, the greater the fecundity which should result in population

Table 3-4. Sex, distance in meters (m) between release site and January 2025 burrow, distance between January 2024 burrow and January 2025 burrow, total distance between monitored locations (January 2024 to January 2025), and total number of burrows and new burrows occupied by 10 tortoises monitored during 2024.

Tortoise Number	Sex	Distance (m) release to January 2025 burrow	Distance (m) between January 2024 and January 2025 burrows	Total distance (m) between locations January 2024-2025	Number of burrows used (new burrows)
4030	Female	2412	127	1777	10 (6)
4039	Female	427	286	2079	8 (5)
4044	Female	3791	3760	6507	8 (6)
4045	Female	130	144	2113	8 (5)
4004	Male	9584	9401	11620	5 (4)
4007	Male	149	0	1150	5 (1)
4011	Male	470	197	4827	8 (4)
4025	Male	975	674	3760	11 (6)
4034	Male	215	261	6465	6 (3)
4036	Male	1110	185	4357	8 (5)
	Average	1926	1504	4466	

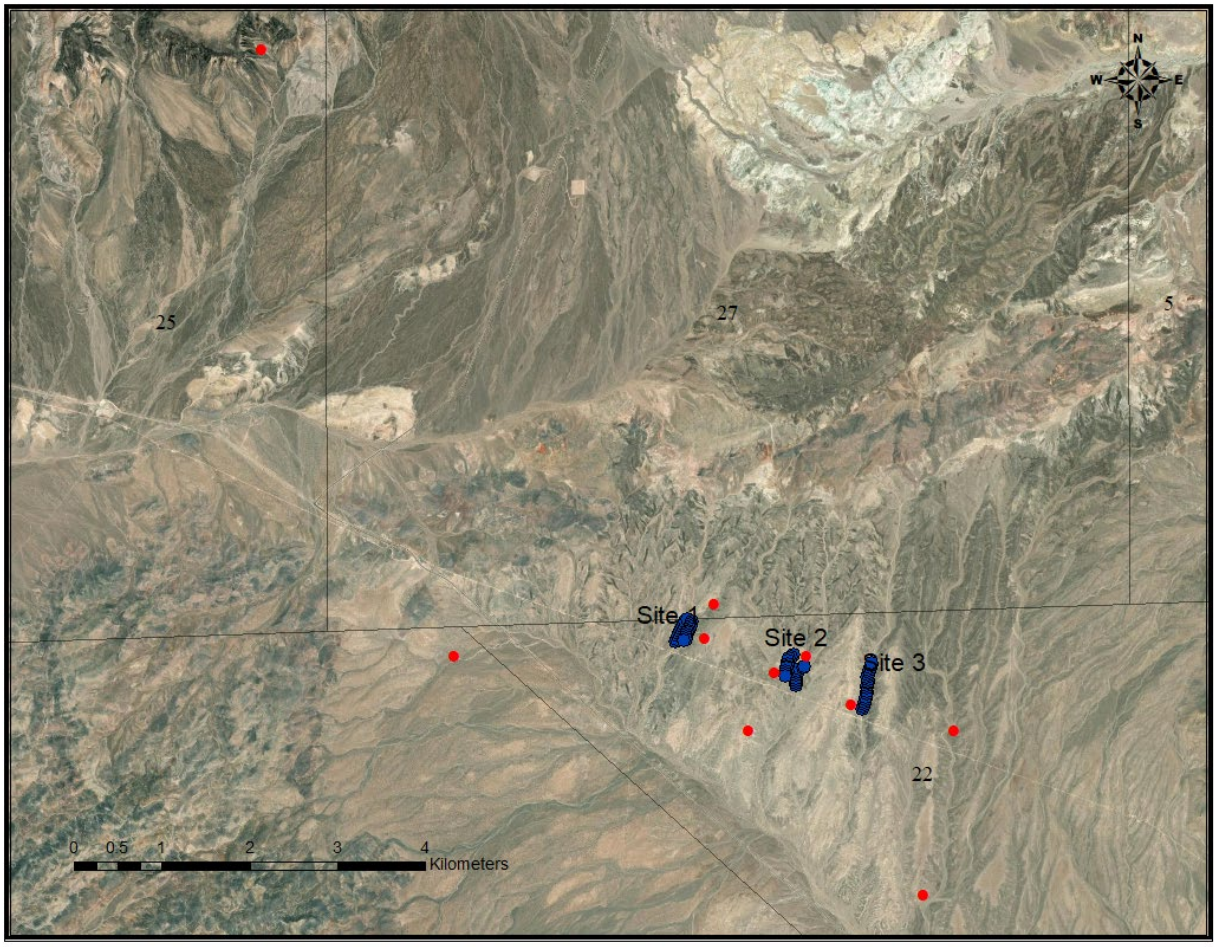

Figure 3-2. Release locations for 60 tortoises, September 2012 (blue dots, 20 at each site) and last known locations for 10 tortoises monitored during 2024 (red dots).

increases. Understanding differential mortality in both resident and translocated juvenile tortoises of both sexes warrants further study.

Table 3-4 contains information about the 10 tortoises monitored during 2024. On average, the distance between the release location and January 2025 burrow was 1,926 m (range = 130 – 9,584, standard deviation [sd] = 2,936). On average, tortoises used winter burrows in 2025, 1,504 m away from their 2024 winter burrows. Only one tortoise wintered in a burrow within 100 m of their last year's winter burrow, which also happened to be the same winter burrow it used the previous year.

The average distance moved between monitoring checks was 4,466 m (range = 1,150 – 11,620 m; sd = 3,152 m). This is not the total distance a tortoise moved during the year, but the summed straight-line distance between locations recorded during regular monitoring. Movements tortoises made between monitoring checks were not recorded or measured. Total distance moved between locations on average in 2024 was 400 m greater than distance moved in 2023 which is due to Male 4004 moving over 10 km in late April/May to settle in a new area. Female 4044 also moved over 6 km and settled in a new area. Increased foraging conditions, greater energy reserves, and more mating opportunities created by the above-normal winter/spring precipitation and abundant plant production may have prompted these long-distance movements.

During 2024, burrows were marked with unique numbers and data collected included UTM coordinates (NAD83), burrow height, burrow width, burrow orientation, elevation, location, topographic position, vegetation cover, and substrate. The number of unique burrows an individual used was calculated and is shown in Table 3-4. Tortoise burrows were only documented during monitoring events, so it is likely that not all burrows used were documented. A total of 77 unique burrows were used during 2024, including 45 new burrows that were marked and measured. The average height of new burrows was 12.4 mm (range = 6 – 23; sd = 3.2) and average width of burrows was 31.5 mm (range = 20 – 173; sd = 24.4). Two caliche burrows had very wide openings. On average, tortoises used 7.7 unique burrows (range = 5 – 11; sd = 1.9) (Table 3-5). Timing of arrival at winter burrows differs between years (Table 3-5) and appears to be influenced by temperature and moisture. If enough moisture is received in the fall to cause plant germination and regrowth and temperatures are mild, tortoises continue to move around and forage into November (Hall et al. 2016). Temperatures were still warm into November but a lack of fall rain provided limited foraging opportunities.

Between early January 2024 and early January 2025, 341 observations were recorded. Tortoises were at burrows 66% of the time and aboveground 34% of the time including under vegetation (21%), in the open (12%), inside the burrow (59%), in the burrow mouth (5%), on the burrow apron (2%), or in a boulder shelter (1%). Of the 73 observations under vegetation, 30% were under blackbrush (*Coleogyne ramosissima*), 15% under pale desert thorn (*Lycium pallidum*), 8% under water jacket (*Lycium andersonii*), 8% under Fremont's dalea (*Psorothamnus fremontii*), 8% under Nevada jointfir (*Ephedra nevadensis*), 6% under creosote bush (*Larrea tridentata*), 15% were under mixed shrub species clumps, and the remaining 10% were under five other shrub (1.4% white bursage [*Ambrosia dumosa*], 1.4% cheesebush [*Hymenoclea salsola*], 1.4% littleleaf ratany [*Krameria erecta*], 1.4% Mexican bladdersage [*Salazaria mexicana*], 1.4% Mojave woodyaster [*Xylorhiza tortifolia*]), and one forb species (1.4% desert globemallow [*Sphaeralcea ambigua*]).

For the 45 new burrows, tortoises used burrows on wash slopes 87% of the time followed by burrows in wash bottoms (9%), washlets (2%), and ridgetops (2%). Vegetation cover at burrows was found at 82% of the burrows, suggesting this may be an important factor in burrow use for these tortoises. Creosote bush was the dominant cover over burrows (27%) followed by Nevada jointfir (16%), pale desert thorn (9%), water jacket (9%), mixed shrub clumps (7%), white bursage (4%), spiny hopsage (*Grayia spinosa*) (4%), littleleaf ratany (2), Fremont's dalea (2%), and a dead unknown shrub species (2%).

Table 3-5. Percentage of tortoises at their winter burrow by October 1 and October 23 and the date by which all tortoises were at their winter burrows for the years 2014–2024.

Year	By October 1 (%)	By October 23 (%)	Date All Tortoises at Winter Burrow
2014	53	90	November 18
2015	4	37	November 23
2016	15	26	November 7
2017	41	89	November 6
2018	38	96	October 29
2019	13	78	December 12
2020	38	88	November 23
2021	25	83	October 28
2022	30	90	November 7
2023	10	70	November 21
2024	10	30	November 18

Gravel was the dominant substrate at 73% of all new tortoise burrows followed by gravel/cobble (9%), cobble (7%), caliche (7%), cobble/caliche (2%), and sandy/gravel (2%). Gravel is defined as rocks <2.5 centimeters (cm) in size, cobble as rocks between 2.5 and 12.7 cm, rock as >12.7 cm, and caliche is a hard layer of rock cemented together by calcium carbonate. Combined categories such as gravel/cobble means that both were equal in abundance.

Evidence of foraging was documented on all 10 tortoises, 40 times between April 3 and September 9, 2024, with foraging peaks in April (20 times) and May (15 times) (Figure 3-3). Documented species eaten in 2024 include bluedicks (*Dichelostemma capitatum*) (5.0%), desert globemallow (2.5%), desert trumpet (*Eriogonum inflatum*) (2.5%), New Mexico plumeseed (*Rafinesquia neomexicana*) (2.5%), lupine species (2.5%), yellow cups (*Chylismia brevipes*) (2.5%), brittle spineflower (*Chorizanthe brevicornu*) (2.5%), red brome (*Bromus rubens*) (2.5%), Arabian schismus (*Schismus arabicus*) (2.5%), and dirt (2.5%). Most (72.5%) of the time, it was not possible to identify what the tortoises had eaten. Winter and spring precipitation (2023-2024) was about 1.6 times normal resulting in high plant production and increased foraging opportunities for tortoises during the spring. A monsoon event in late July resulted in some green up which did not persist into September so there was little opportunity for foraging in the fall. Record heat also caused vegetation to dry out quickly.

Transmitters were changed out in the fall and health assessments were completed for all 10 tortoises. All 10 tortoises were also measured and weighed and given a Body Condition Score (BCS) in both spring and fall. Table 3-6 contains information on MCL (mm) and BCS for fall 2012 (pre-release), spring 2024 and fall 2024, as well as weight without transmitter (grams [g]) for fall 2012 (pre-release) and fall 2024. Also included is the growth (mm) in MCL between 2012 and 2024 and spring and fall 2024 which averaged 68 mm and 6 mm, respectively. The 2024 growth is attributed to the above-normal winter and spring precipitation (1.6 times normal) that resulted in abundant plant production in the spring. Also included is the weight gain (g) from 2012 to 2024 which averaged over one kilogram (kg).

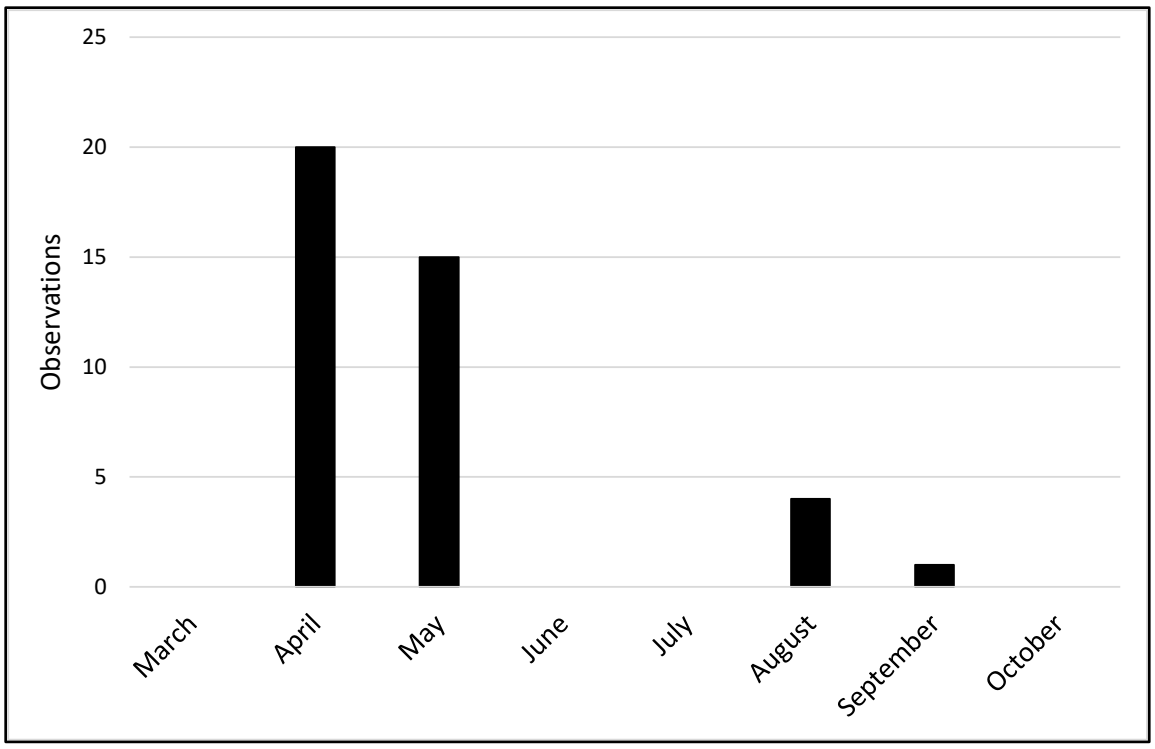

Figure 3-3. Number of times evidence of foraging was detected by month for 10 tortoises, January 2024–January 2025 (n = 40) (no evidence of foraging was detected in January, February, March, June, July, October, November, or December).

Results from health assessments showed that all tortoises were in good condition (BCS 4) (BCS 1-3, under condition; BCS 4-6, good condition; BCS 7-9, over condition). Some observations from the health assessments include: two tortoises (Female 4030 and Male 4034) had a few ticks; one tortoise (Male 4007) had sunken eyes; two tortoises (Males 4011 and 4007) had mild serous discharge from the left and right eye, respectively; and three tortoises (Females 4044 and 4045, Male 4034) had localized trauma on the carapace and/or plastron, including damage from an old predator attack on Female 4044.

The main factor for survival appears to be sex with higher survival of males than females. This has been observed by other researchers as well (Esque et al. 2010; Melia Nafus, San Diego Zoo Global, personal communication, December 4, 2014). Size, weight, overall health, and presence of *Mycoplasma* species (bacteria that causes upper respiratory disease in tortoises) do not seem to have any significant impact on survival. While it is difficult to determine if a tortoise was scavenged or preyed upon, a majority of dead tortoises have shown signs of being chewed on by mammalian predators. Given the presumed healthy status and low disease prevalence in the juveniles, it seems unlikely that they are dying and then being scavenged. This suggests that most of the mortality is due to predation. Coyote and kit fox tracks have been observed on multiple occasions while conducting tortoise monitoring and at several of the mortality sites which suggests these canids are the main predators of our study animals. To better understand the predator community and visitation frequency, a camera trap was set up at Site 2 for a total of 2,218 days between from 2017-2024. Results showed 18 coyote images which is about one every 123 days, 15 kit fox images which is about one every 148 days, 14 badger (*Taxidea taxus*) images which is about one every 158 days, and 4 bobcat (*Lynx rufus*) images which is about one every 555 days.

Why canid predation is higher on females than males is a question yet to be answered. It does not appear to be due to females being aboveground more than males or moving farther (Hall and Perry 2020). Coyotes and kit foxes use olfaction as one of their dominant senses, therefore it is possible that

differences in chemical signatures between females and males either attract or repel canid predators. Differences between juvenile female and male chemical signatures have been identified but results from field trials did not find a difference in predator response, either positive or negative, to the synthesized female and male tortoise scent (Hall et al. 2023). Further research is needed to determine if differential canid predation between females and males is occurring in natural or other translocated populations and to investigate the predation ecology of canids on tortoises and possible deterrents.

A habitat selection study was completed during 2023 to determine if the translocated juvenile tortoises are selecting for specific habitat features such as position (e.g., under vegetation, in the open), plant species composition, landform (e.g., wash bottom, wash slope, ridge), and substrate (e.g., sand, gravel, cobble). Data were collected and entered and are in the process of being analyzed.

Overall, the remaining 10 translocated tortoises seem to be doing well. Moderate seasonal growth in MCL was observed in most of the tortoises. Above-normal winter/spring precipitation resulted in good plant production which allowed for mating and foraging opportunities. Lack of significant fall precipitation led to limited foraging opportunities before brumation. NNSS biologists will continue monitoring the remaining tortoises.

3.2.4 Coordination with Other Biologists and Wildlife Agencies

- NNSS biologists attended the Desert Tortoise Council 49th Annual Meeting and Symposium February 20-23. This is an annual event that brings together experts to discuss tortoise conservation.

- NNSS biologists are working on a manuscript titled, “Factors Influencing Survival of Translocated Juvenile Desert Tortoises of Known Sex in Southern Nevada” and contains results from the first 10 years of the study.

- NNSS biologists are coordinating with FWS Desert Tortoise Recovery Office to potentially translocate displaced tortoises from other projects to the NNSS.

- NNSS biologists are coordinating with FWS and biologists managing construction of solar facilities to develop wildlife-friendly construction techniques for upcoming solar projects on the NNSS. NNSS biologists visited multiple offsite solar facilities and met with FWS and other biologists to determine the best methods to minimize impacts to the tortoise and its habitat. These techniques will be recommended for upcoming solar projects on the NNSS.

- NNSS biologists participate in the DOE Endangered and Threatened Species Working Group which focuses on better understanding DOE’s endangered species programs, networking federal contacts, and common obstacles for species management.

Table 3-6. Midline carapace length (MCL) (mm), body condition score, weight without transmitters (g), MCL growth and weight gain from fall 2012 to fall 2024, and MCL growth spring 2024 to fall 2024 for 10 tortoises monitored in 2024.

Tortoise Number	Sex	Pre-release MCL (mm) 2012	MCL (mm) (Spring 2024)	MCL (mm) (Fall 2024)	MCL Growth (mm) 2012-2024	MCL Growth (mm) Spring to Fall 2024	Pre-release Weight (g) (2012)	Weight (g) (Fall 2024)	Weight gain (g) 2012-2024	Pre-release Body Condition (2012)	Body Condition (Spring 2024)	Body Condition (Fall 2024)
4030	Female	148	204	201	53	-3	562	1700	1138	4	4	4
4039	Female	117	178	184	67	6	315	1200	885	5	4	4
4044	Female	146	209	216	70	7	484	1800	1316	4	4	4
4045	Female	129	185	192	63	7	400	1250	850	4	4	4
4004	Male	117	188	193	76	5	303	1200	897	4	4	4
4007	Male	121	153	160	39	7	363	807	444	5	4	4
4011	Male	144	225	228	84	3	634	2000	1366	4	4	4
4025	Male	127	205	212	85	7	357	1500	1143	5	4	4
4034	Male	128	190	200	72	10	407	1500	1093	4	4	4
4036	Male	132	193	200	68	7	455	1350	895	4	4	4
	Average	**131**	**193**	**199**	**68**	**6**	**428**	**1431**	**1003**	**4**	**4**	**4**

4.0 ECOSYSTEM MONITORING

Biologists began comprehensive mapping of plant communities and wildlife habitat on the NNSS in 1996. Data were collected, describing selected biotic and abiotic habitat features within field mapping units called ELUs. ELUs are landforms (Peterson 1981) with similar vegetation, soil, slope, and hydrology. Boundaries of the ELUs were defined using aerial photographs, satellite imagery, and field confirmation. ELUs are considered by NNSS biologists to be the most feasible mapping unit by which sensitive plant and animal habitats can be described. In 2000 and 2001, topical reports describing the classification of vegetation types on the NNSS were published (Ostler et al. 2000, Wills and Ostler 2001). Ten vegetation alliances and 20 associations were described on the NNSS.

In addition to ELU mapping, ecosystem monitoring also entails monitoring a wide variety of terrestrial and aquatic habitats and non-sensitive and protected/regulated species. Efforts during 2024 focused on wildland fire fuel surveys, natural water source monitoring, and constructed water source monitoring, including contaminated sumps. Scorpion survey results and opportunistic reptile observations are also included.

4.1 Wildland Fires, Fuel Surveys, and Recovery Plans

Wildland fires on the NNSS can cause significant ecological damage and require considerable financial resources for fire suppression and mitigation. Estimated costs for fire suppression efforts for the 2021 Cherrywood Wildland Fire were $457 per ha. Costs incurred from the Egg Point Fire in August 2002 (121 ha) were well over $1 million to replace one mile of burned power poles, and more than $200,000 for soil stabilization and revegetation of the burned area. The loss of wildlife habitat and ecosystem function is also a big problem, especially in mid-elevation areas where conversion to invasive annual grasslands degrades habitat and greatly increases the frequency of wildland fires in those areas. Because of these impacts there is a need to minimize the number and extent of wildland fires and assess the annual wildland fire risk. This section contains information about wildland fires that occurred on the NNSS during 2024, and methods and results of fuel surveys designed to assess annual wildland fire risk on the NNSS.

4.1.1 Wildland Fires in 2024

From 1978 to 2024, an average of 9.8 wildland fires per year and about 125 ha per fire have burned on the NNSS. Many wildland fires are caused by lightning and do not occur randomly across the NNSS but occur more often in particular vegetation types (e.g., blackbrush and pinyon pine/Utah juniper/sagebrush species [*Pinus monophylla/Juniperus osteosperma/Artemisia* species {spp.}] plant communities). These vegetation types have sufficient woody and fine-textured fuels that are conducive to ignition and spread of wildland fires. Once a site burns, it is much more likely to burn again because of the invasive annual plants that quickly colonize these areas (Brooks and Lusk 2008).

Five wildland fires were documented on the NNSS in 2024. Three were human-caused or project related, one was caused by lightning, and one was caused by an unknown source. The Ribbon Cliff Fire was the largest and burned approximately 3,228 ha in primarily sagebrush habitat in Area 20. The remaining fires were all <0.5 ha in size.

4.1.2 Wildland Fire Recovery Plans

A relatively new requirement identified in the Consolidated Emergency Management Plan (NFO-EOC-PLN-101) necessitates the development of recovery plans for specified fires based on their impact and magnitude of acreage burnt. Due to its large size, a recovery plan was written for the Ribbon Cliff fire (PLN-2120-RBWF). NNSS biologists contributed information and recommendations to the recovery plan on impacts to species protected under the ESA; sensitive and protected/regulated plant and animal species; vegetation changes, conversion to annual grassland, and potential rehabilitation measures; and wind and water erosion potential.

4.1.3 Fuel Survey Methods

Beginning in 2004, and in response to U.S. Department of Energy Order 231.1B Environment, Safety and Health Reporting (DOE 2012), surveys were initiated on the NNSS to identify wildland fire hazards. Vegetation surveys were conducted between April 24 and May 31, 2024, at sites located along and adjacent to major NNSS corridors to estimate the abundance of fuels produced by native and invasive annual and perennial plants. Information about climate was also identified and summarized as part of the wildland fire hazards assessment.

The abundance of fine-textured (grasses and herbs) and coarse-textured (woody shrubs and trees) fuels were visually estimated on numerical scales using an 11-point potential scale: 0 to 5 (in 0.5 increments, where 0.0 is barren and 5.0 is near maximum biomass encountered on the NNSS). Details of the methodology used to conduct the spring survey for assessing wildland fire hazards on the NNSS are described in a report by Hansen and Ostler (2004).

Photographs of sites typifying these different scale values are found in Appendix A of the *Ecological Monitoring and Compliance Program Calendar Year 2005 Report* (Bechtel Nevada 2006). Additionally, the numerical abundance rating for fine fuels at a site was added to the numerical abundance rating of woody fuels to derive a combined fuels rating for each site that ranged from 0 to 10 in one-half integer increments. The index ratings for fuels at these survey sites were then plotted on a GIS map and color-coded for abundance to indicate the wildland fire fuel hazards at various locations across the NNSS.

4.1.4 Fuel Survey Results

4.1.4.1 Climate

There are 17 rain gauges on the NNSS (Hansen and Ostler 2004) that have been used historically to measure precipitation. Data from these weather station gauges extends back more than 30 years (https://www.sord.nv.doe.gov/ForecastPage.php?Forecast=Weather; NOAA 2025). In the fall of 2011, most of the rain gauges on the NNSS were upgraded from weighing gauges to tipping-bucket style gauges with data transmitted directly to the National Oceanic and Atmospheric Administration (NOAA) via telecommunications, rather than manually retrieving and processing the data. In most cases, the new gauges were relocated nearby to facilitate data collection. The changes were made to reduce costs, improve data reliability, and improve access time to the data after precipitation events. As a result of these modifications, only 14 rain gauges remain from the original gauge stations. The Cane Spring, Tippipah Spring, and Rock Valley gauge stations were decommissioned. The Jackass Flats gauge was moved to Port Gaston in Area 26. The Little Feller 2 gauge was moved from the eastern part of Area 18 to the northwestern corner of Area 18. Precipitation data collected in 2024 reflect the changes and attempt to match,

as closely as possible, data collected historically. Mean values were recalculated to account for periods when gauges were not functional.

To assess whether the spring of the year would be relatively wet, normal, or dry, a simple measure of precipitation was needed. Precipitation during the months of December, January, February, March, and April was selected because of its simplicity and ease of calculation (Figure 4-1). While it is recognized that precipitation from other months is also important, as is the influence of temperature, winds, and relative humidity, precipitation during these months represents the period that most influences plant growth on the NNSS as observed along the survey route. This period occurs before the beginning of the fire season in June so it allows one to make a prediction of the fuels that may be present. During the first 10 years of conducting fire fuel evaluations (2004–2013), the mean precipitation during these 5 months was correlated (R = 0.770) with our estimations of the combined fuel loads. During 2024, the average precipitation from the remaining 14 rain gauge stations on the NNSS during December–April was 171.0 mm, which is about 1.6 times greater than the long-term average (2004–2024) of 105.7 mm received on the NNSS. This was the third highest amount recorded since 2004.

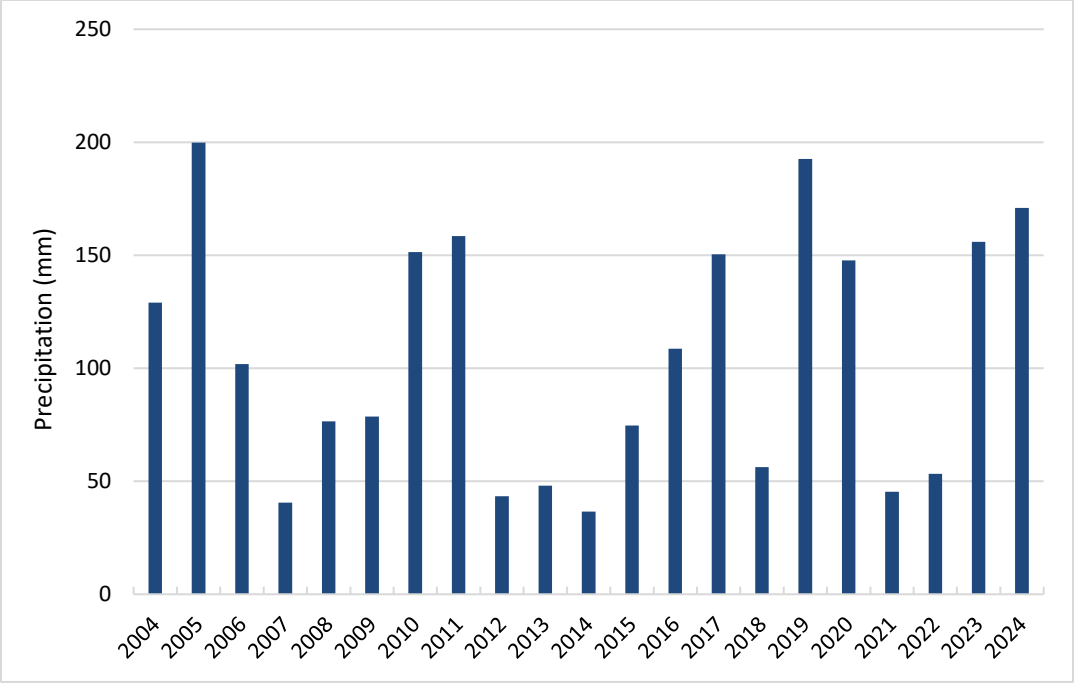

Figure 4-1. Average precipitation from December (previous year) through April for the years 2004 through 2024 (long-term average [2004-2024] 105.7 mm).

4.1.4.2 Fuels

Due to the well above-average precipitation received during winter/spring 2023–2024, production of annual forbs and grasses was high. Production of perennial herbaceous grasses and forbs was also high. Some residual fine fuels were observed in 2024.

The fine-textured fuels index increased from 2.19 in 2023 to 2.37 in 2024 which is above the long-term average (2004-2024) of 2.14 (Table 4-1). Fine fuels were comprised of a mix of native grasses and forbs and invasive annual grasses, mostly red brome and cheatgrass (*Bromus tectorum*). Brome production was high in 2024, especially at the middle elevations. This was

Table 4-1. Woody fuels, fine fuels and combined fuels index values for 2004–2024.

Year	Average Woody Fuels Index	Average Fine Fuels Index	Average Combined Fuels Index
2004	2.75	2.13	4.88
2005	2.80	2.83	5.64
2006	2.80	2.46	5.26
2007	2.62	1.52	4.13
2008	2.59	2.23	4.81
2009	2.63	1.95	4.52
2010	2.61	2.27	4.89
2011	2.58	2.56	5.14
2012	2.43	1.75	4.17
2013	2.49	2.03	4.52
2014	2.44	1.39	3.83
2015	2.42	1.44	3.87
2016	2.43	2.67	5.10
2017	2.49	2.38	4.87
2018	2.49	1.83	4.32
2019	2.59	2.41	5.00
2020	2.60	2.53	5.13
2021	2.56	2.14	4.70
2022	2.56	1.79	4.35
2023	2.56	2.19	4.75
2024	2.63	2.37	5.00
Average 2004-2024	**2.57**	**2.14**	**4.71**

different than the cool, wet spring experienced in 2023 which was not conducive to abundant brome production. At the higher elevations, native perennial grasses and forbs were abundant with good biomass production. When these dry out, they will provide fuel for the potential spread of wildland fires.

The coarse-textured or woody fuels index value increased from 2.56 in 2023 to 2.63 in 2024 (Table 4-1). This was an above-average value in comparison to the other index values since 2004. Woody values are not expected to change as much as fine fuel values due to the longer life span of shrub and tree species that comprise the woody fuels category. Pinyon pine trees in several areas along Pahute Mesa Road showed signs of stress especially at the lower elevations where this species occurs, most likely caused by prior drought conditions. If a large scale dieoff occurs this would create a tremendous fuel load of highly flammable material. Trees in these areas will be monitored over the next few years to assess their status.

The combined index value (fine fuels plus woody fuels) corresponds to the potential for fuels on the NNSS to support wildland fires once fuels are ignited. The higher the index, the greater the potential for wildland fires to spread. The NNSS average combined index value for fine fuels and woody fuels increased from 4.75 in 2023 to 5.00 in 2024 (Table 4-1). This is higher than the long-term average (2004–2024) value of 4.71, suggesting a higher-than-average fuel load for the NNSS in 2024.

The locations and results of the fine fuels, woody fuels, and combined fuels surveys at 104 stations on the NNSS inspected during 2024 are shown in Figures 4-2, 4-3, and 4-4, respectively. The highest combined index values (Figure 4-4) and thus, the highest potential for wildland fires, occur in Fortymile Canyon (mostly previously burned areas), southern Yucca Flat (blackbrush), Buckboard Mesa (sagebrush), and northeast Big Burn Valley (pinyon-juniper). High amounts of fine fuels were found in Fortymile Canyon, southern and northern Yucca Flat, and Mid Valley (Figure 4-2). High amounts of woody fuels were primarily found in the forested portions of Pahute Mesa, but also occurred along Stockade Wash Road, Cane Spring Road and upper Fortymile Canyon (Figure 4-3).

Photographs were taken from permanent locations for all 104 sites during the past 16 years. For example, Figure 4-5 shows photographs of Site 99 in Yucca Flat for the years 2021, 2022, 2023, and 2024. These photographs are valuable for many reasons, including providing a permanent record of previous site conditions, comparing site conditions among sites and years, and evaluating current year production with residual fuels from previous years.

4.1.4.3 Invasive Plants

The three most commonly observed invasive annual grasses to colonize the NNSS are Arabian schismus (*Schismus arabicus*), found at low elevations; red brome, found at low to moderate elevations; and cheatgrass, found at all elevations (Table 4-2). Values in Table 4-2 only reflect plants germinated this year. Cheatgrass was the most common invasive plant found in 2024 occurring at 87.5% of the sampling locations, the highest documented since sampling began in 2004. While it was predominantly found at middle to higher elevations it was found at lower elevation sites as well. Maximum cheatgrass biomass was observed in previously burned areas in Fortymile Canyon and Mid Valley. Similar to 2023, red brome was found at nearly 60% of the sites, and Arabian schismus which is only found at lower elevations was found at about a quarter of the sites.

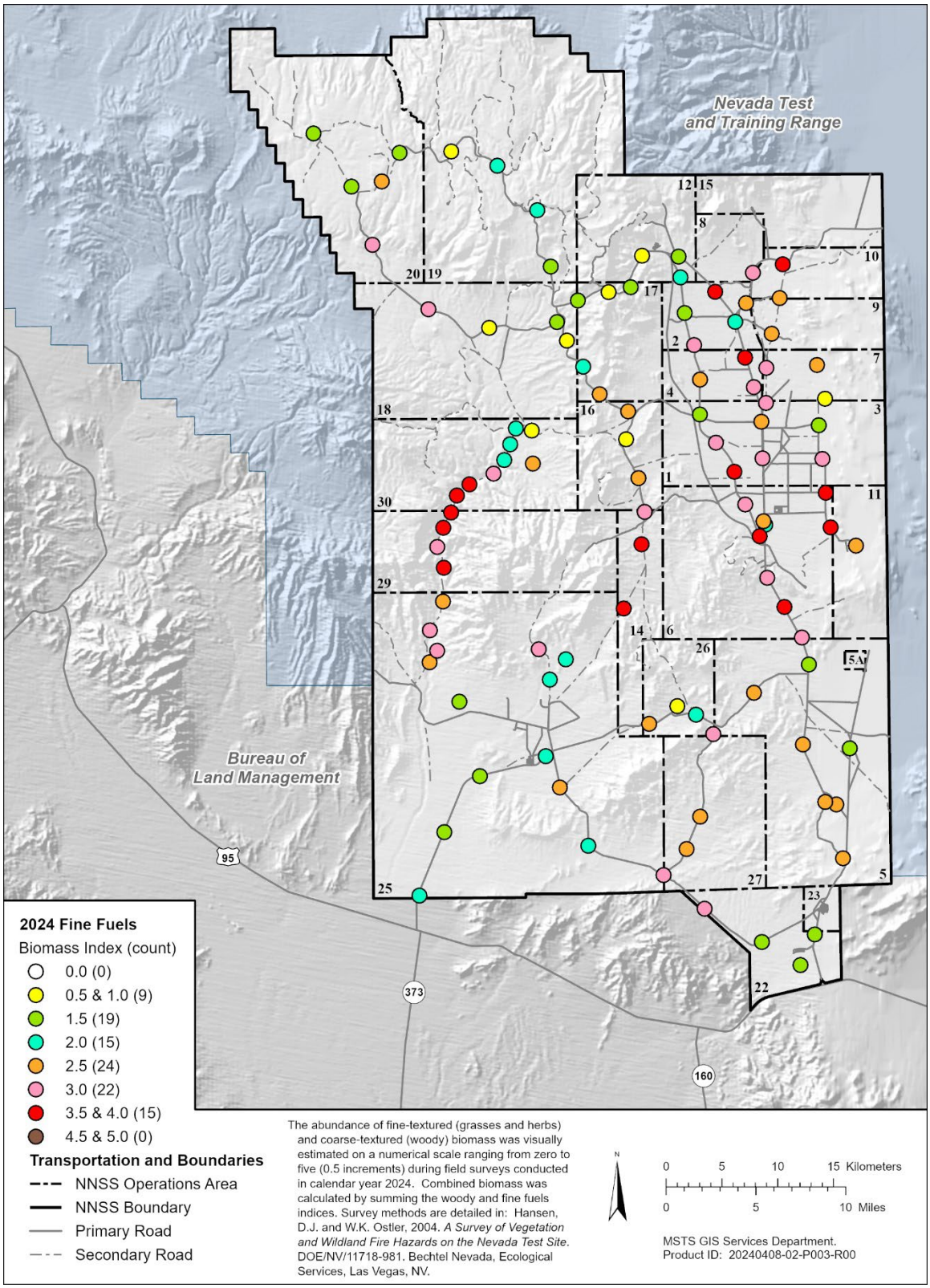

Figure 4-2. Index of fine fuels for 104 survey sites on the NNSS during 2024.

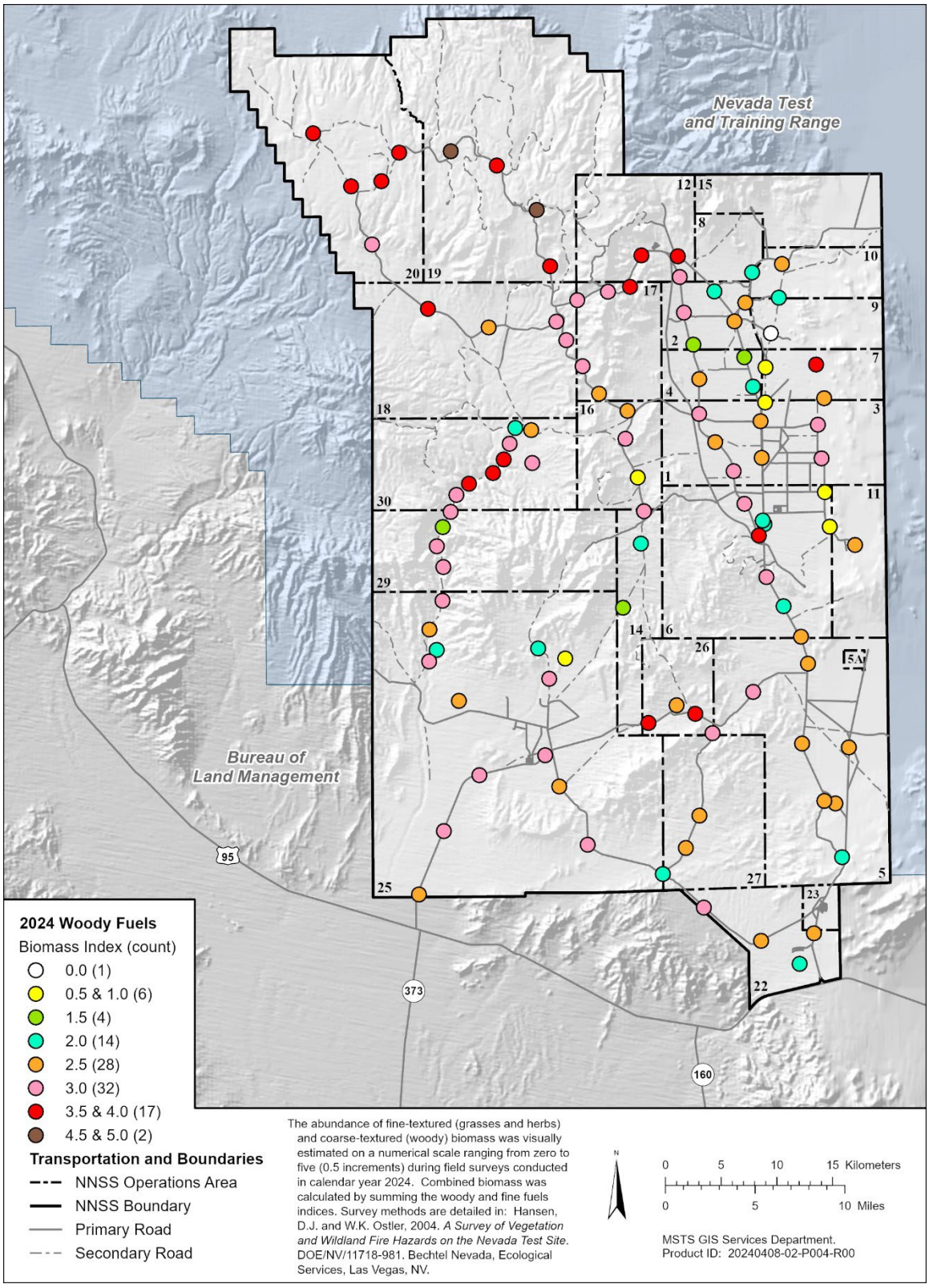

Figure 4-3. Index of woody fuels for 104 survey sites on the NNSS during 2024.

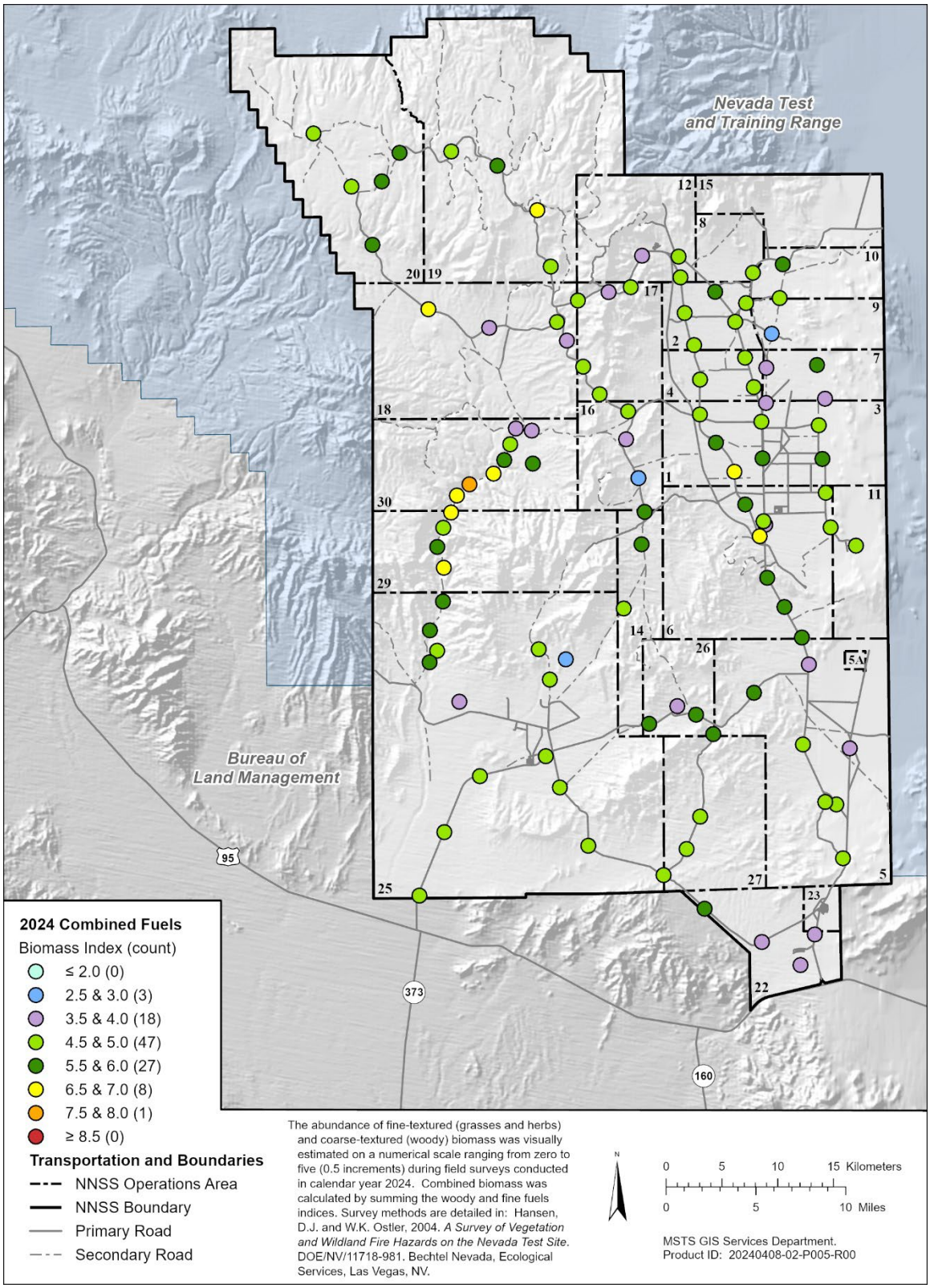

Figure 4-4. Index of combined fine fuels and woody fuels for 104 survey sites on the NNSS during 2024.

Figure 4-5. Site 99 on the west side of Yucca Flat in 2021, 2022, 2023, and 2024.
(Photos by J. Hannon, May 20, 2021 [top left], May 10, 2022 [top right], D. Hall May 16, 2023 [bottom left], and F. Diaz May 7, 2024 [bottom right]).

Table 4-2. Precipitation history and percent presence of key plant species contributing to fine fuels at surveyed sites, 2007-2024 (* = not calculated).

Precipitation History	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Mean Precipitation (mm) (December–April)	40.6	76.5	78.7	151.4	158.5	43.4	48.0	36.6	74.7	108.7	150.4	56.3	192.6	147.7	45.3	53.3	155.9	**171.0**
Invasive Introduced Species																		
Bromus rubens (red brome)	0	63.0	63.2	58.5	62.3	0	19.2	28.8	52.9	54.8	68.3	43.3	67.3	68.3	18.3	31.7	58.7	**60.6**
Bromus tectorum (cheatgrass)	0	59.2	66.0	67.0	79.2	17.0	70.2	61.5	36.5	69.2	79.8	59.6	78.8	79.8	24.0	51.0	81.7	**87.5**
Erodium cicutarium (redstem stork's bill)	0	21.3	27.4	33.0	42.4	0.9	37.5	33.7	25.0	43.3	47.1	46.2	50	45.2	2.9	11.5	26.9	**34.6**
Schismus arabicus (Arabian schismus)	0	11.4	9.4	3.8	11.3	0	9.6	6.7	10.6	15.4	15.4	21.1	18.3	9.6	1.0	1.0	23.1	**24.0**
Native Species																		
Amsinckia tessellata (bristly fiddleneck)	0	63.0	48.1	67.9	63.2	1.8	41.3	26.0	47.1	66.4	54.8	50	65.4	59.6	1.0	26.0	58.7	**45.2**
Mentzelia albicaulis (whitestem blazingstar)	0	2.4	18.9	51.9	16.0	3.7	6.7	20.2	43.3	41.4	25.0	3.8	23.1	7.7	3.8	17.3	20.2	**5.8**
Chaenactis fremontii (pincushion flower)	0	1.4	11.3	13.2	0.5	0	6.7	2.9	7.7	32.7	38.5	12.5	28.8	10.6	0	8.7	6.7	**5.8**
Sphaeralcea ambigua (desert globemallow)	*	*	*	*	*	*	*	*	*	32.7	36.5	32.7	31.7	41.3	23.1	26.9	42.3	**57.7**

Native annual and perennial forbs were abundant this year due to the above-average precipitation (Table 4-2). Desert globemallow was found at 57.7% of sampling locations, the highest detected since it was included in 2016 (Table 4-2). This species is a native, perennial forb found throughout the NNSS. It likes disturbance and can form dense patches in road shoulders and previously burned areas.

Precipitation history (Figure 4-1, Table 4-2) is important in determining the percent presence of species across the NNSS. During periods of low precipitation, most annual species have low percent presence (i.e., the number of sites in which the plant was observed to be present and growing). Percent presence is generally greatest during periods of high precipitation and appears to be a good indication of germination. Higher percent presence is also expected to occur when regional storms provide precipitation to a greater number of operational areas across the NNSS. However, the response of some species, both invasive and native species, suggests that other variables, such as the timing of precipitation or temperatures required for germination, may also be contributing to plant response both in terms of plant abundance and biomass produced.

Colonization by invasive species such as cheatgrass, red brome, and Arabian schismus increases the likelihood of future wildland fires because they provide abundant fine fuels that grow under shrubs as well as in the interspace between shrubs which allows fire to spread from one shrub to another, thus creating a near continuous fuel layer. Blackbrush vegetation types appear to be the most vulnerable plant communities to fire, followed by pinyon pine/Utah juniper/sagebrush species vegetation types. Wildland fires are costly to control and to mitigate once they occur. Revegetation of severely burned areas can be very slow without reseeding or transplanting with native species and other rehabilitation efforts such as herbicide treatments that can be costly. Blackbrush, sagebrush, juniper and pinyon pine do not resprout following fires. Untreated areas become much more vulnerable to future fires once invasive grass species, rather than native species, colonize a burned area.

Overall, the combined fuel load for 2024 was above average creating conditions conducive for wildland fires to occur, especially in areas such as Fortymile Canyon, Mid Valley, and the eastern slopes of Timber Mountain that have burned previously and now consist of almost pure stands of cheatgrass and/or red brome. Early detection and rapid fire suppression response by NNSS Fire and Rescue after fire ignition are key factors in minimizing wildland fire spread and severity.

4.1.5 Sahara mustard (*Brassica tournefortii*)

Sahara mustard (*Brassica tournefortii*, synonyms: African or Asian mustard, wild turnip) is an invasive, introduced, annual weed that invades disturbed areas (e.g., roadsides, areas disturbed by heavy equipment, naturally disturbed areas) quickly with a single plant capable of propagating thousands of seeds (McDonald 2023) (Figure 4-6). Sahara mustard has a quick life cycle, does not need a lot of soil moisture, and can flower as early as February in the Mojave Desert (U.S. Department of Agriculture Forest Service 2017). It seems to germinate and grow mainly during years of above-normal winter precipitation. The plant grows taller than native annuals and outcompetes native plants for light, water, and resources (McDonald 2023). The plants are robust and form dense stands where they invade. Berry et al. (2014) suggest it is an invasive "transformer" species, capable of transforming an ecosystem. Sahara mustard contains toxic oxalates and is not a good food plant (Abella and Berry 2016, Jacobson et al. 2009). Plants have spread throughout the Mojave Desert into tortoise habitat. Recovery of the tortoise includes improving forage quality and quantity by decreasing nonnative plants that create low diversity stands (Abella and Berry 2016).

Sahara mustard has been known to occur in Area 25 on the NNSS since 2008, along the road shoulders and decommissioned buildings on Lathrop Wells Road. Up until recently, it was thought the population had not spread. The plant recently was observed at three different locations in Area 25: MX Racetrack, 2nd

Figure 4-6. Sahara mustard plant growing at 2nd Street Helipad in Area 25.

(Photo by J.A. Hannon, March 27, 2024)

Street Helipad, and Yucca Mountain Borrow Pit (Figure 4-7). The invaded area is approximately 31 ha and all locations are previously disturbed with plants starting to spread into intact habitat at the 2nd Street Helipad. There has been an increase in DOE activities in Area 25 with an increase in traffic along Lathrop Wells Road (117% increase in average vehicle passes per day) and Jackass Flats Road (34% increase) since 2012 (Hall and Perry 2024). This may have contributed to the spread of seeds by vehicles.

Due to the invasion of Sahara mustard in tortoise habitat in Area 25, NNSS biologists began an eradication program in 2024. In early spring, biologists hand-removed plants to prevent the spread of seeds. Most plants had immature seed pods, while others were flowering (Figure 4-8). Thirty-two large trash bags of plants were removed from March 27-April 2: 20 bags from the largest population, MX

Figure 4-7. Locations of the known Sahara mustard populations in Area 25. Coordinates in UTM NAD83 (Zone 11, meters).

Racetrack, and 12 bags from the 2nd Street Helipad population. An herbicide treatment plan has been developed for late January-early February 2025. Treatment will consist of a pre-emergent (Rejuvra [indaziflam]) to target the seed bank and pre/post-emergent (Panoramic [imazapic]) to target early-growth plants. Herbicide treatments will cover previously disturbed areas, while hand-removal of plants will continue in disturbed and undisturbed invaded areas. Eradication of Sahara mustard takes "consistent and repeated efforts" and "can be achieved after 3 to 4 years of consistent and timely control efforts" (McDonald 2023).

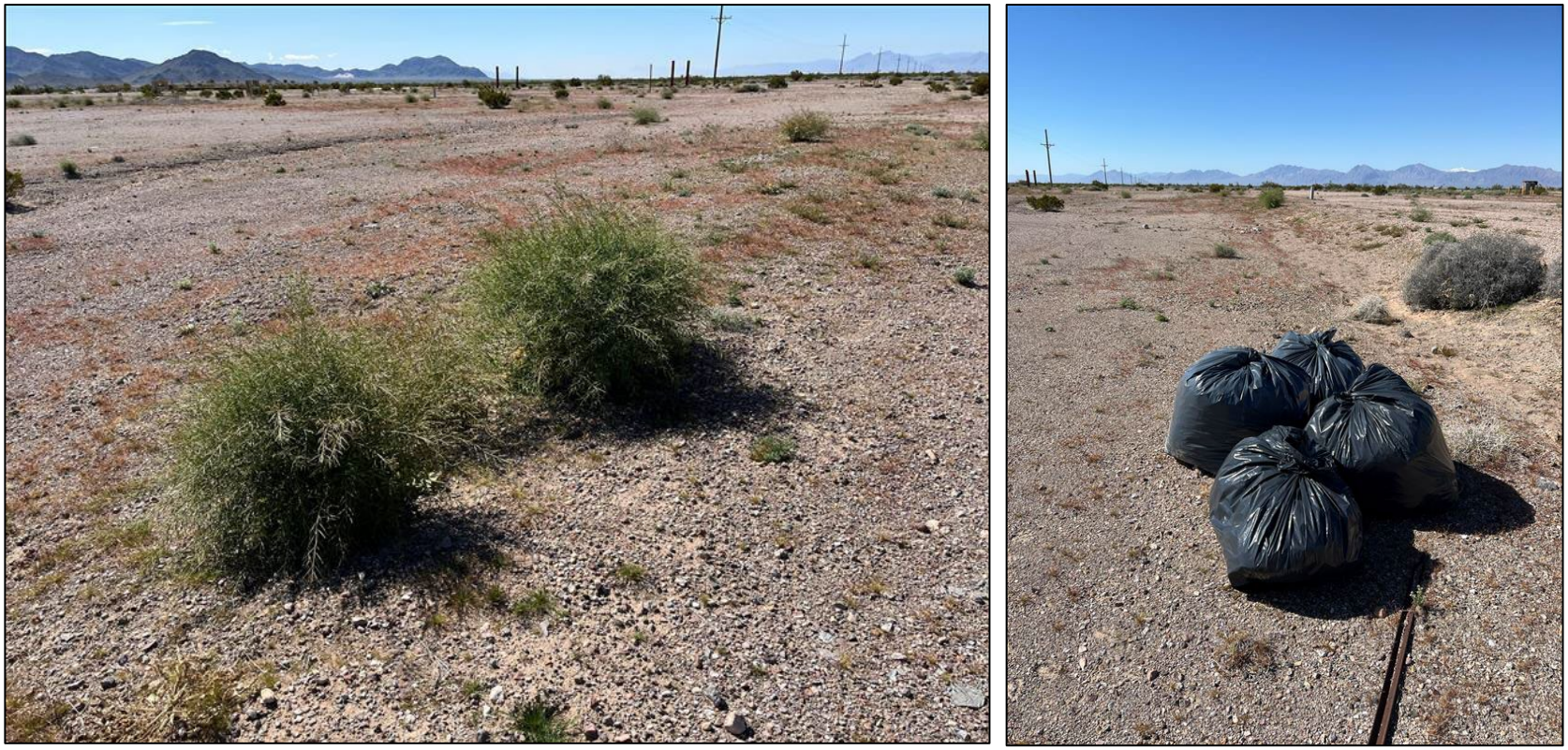

Figure 4-8. Sahara mustard plants with seed pods at MX Racetrack in Area 25 (left) and same area showing a few bags of plants after plants were removed by hand (right).

(Photo by J.A. Hannon, March 28, 2024)

4.2 Reptile Studies

No formal trapping or roadkill studies took place in 2024. However, some opportunistic reptile observations were documented. The purpose of ongoing reptile sampling is to fill in data gaps for species that have not been documented recently or are rare on the NNSS.

Five sidewinder rattlesnakes (*Crotalus cerastes*), including a hatchling and a juvenile, were moved away from facilities (DAF Area 6, EMAD Area 25, Area 5 RWMC, Mercury Area 23) for human safety. Additionally, an adult speckled rattlesnake (*Crotalus mitchelli*) was removed from building CP65 in Area 6 and released. A juvenile red racer (*Masticophis flagellum*), two ground snakes (*Sonora semiannulata*), a young desert spiny lizard (*Sceloporus magister*), and a juvenile western banded gecko (*Coleonyx variegatus*) were extracted on separate occasions from glue traps (all in Mercury) and released into the desert.

4.3 Yucca Mountain Project Specimens

Several animal specimens collected during the Yucca Mountain Project (YMP) site characterization activities under proper authorization and permits were turned over to NNSS biologists to be included in their specimen collection. NDOW was notified that the YMP specimens were being added to the NNSS collection. Among the specimens were a bobcat, kit fox, black-tailed jackrabbit (*Lepus californicus*) several bats, several rodents, a desert tortoise, and a variety of snakes and lizards. These will be used for educational purposes and as voucher specimens.

4.4 Scorpions

Currently, there are 11 scorpion species known to occur on the NNSS (Wills and Ostler 2001). The California Academy of Science is conducting a widespread study to better define scorpion taxonomy with the potential of discovering new species. On August 28, Corey Lange, Bureau of Land Management (BLM) wildlife biologist, and an NNSS biologist conducted a scorpion survey at four locations: north Frenchman Flat, central Yucca Flat, northwest Yucca Flat, and southeast slope of Rainier Mesa. Scorpions were found at each site and several specimens were collected for genetic analysis as part of the widespread taxonomic study.

4.5 Natural Water Source Monitoring

Ten natural water sources (six springs, four rock tanks) were monitored with motion-activated cameras in 2024 to document the presence of mountain lions (*Puma concolor*) and other wildlife (Figure 4-9). Results are found in Table 6-6 with site numbers referenced in Figure 6-21 (see Section 6.11.1, Motion-Activated Cameras). General assessments were also made of each spring and surrounding area to document major disturbances or changes to these important water sources. During 2024, Topopah Spring cave pool was nearly dry with just a couple of small wet spots but the hillside above the cave pool was wet with some standing water. Vegetation was heavily trampled primarily by feral burros *(Equus asinus*) at Twin Spring and Cottonwood Spring with numerous burro trails on the slopes leading to the springs. Vegetation at Captain Jack Spring was dense in the absence of feral horses (*Equus caballus*) using the perennial spring, and cattails (*Typha domingensis*) were very dense around Cane Spring. Gold Meadows Spring had good water in the spring and early summer but dried up around the middle of August and remained dry the rest of the year.

Gold Meadows Spring (#13) had the greatest species richness with 949 images of 10 mammals and 25 birds. A rare observation of a common blackhawk (*Buteogallus anthracinus*) was recorded on July 7 (Figure 4-10) and 126 images of golden eagles were taken. Other uncommon sightings of a common loon

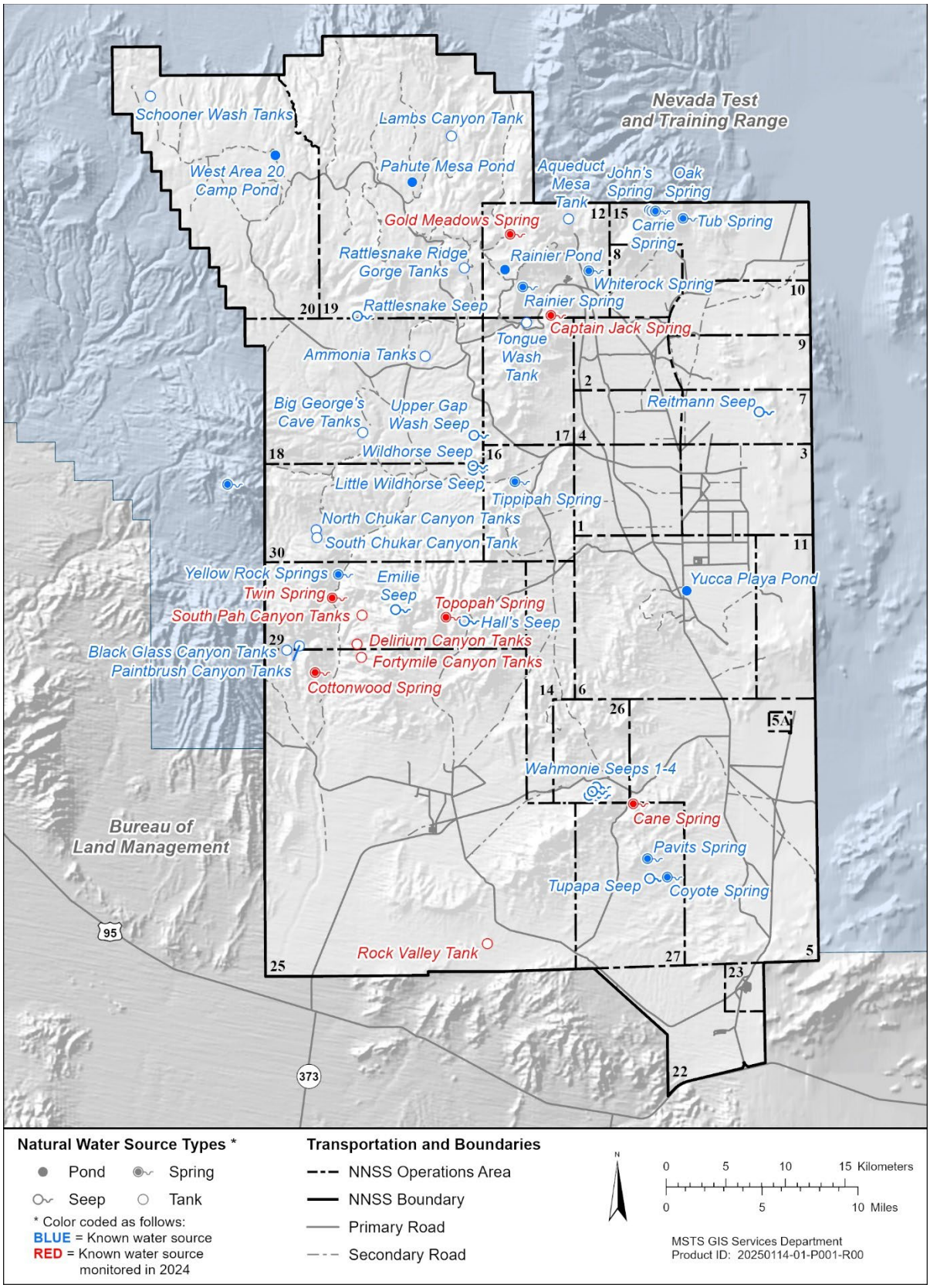

Figure 4-9. Natural water sources on the NNSS, including those monitored in 2024.

Figure 4-10. Rare sighting of a common blackhawk, Gold Meadows Spring (#13).

(Photo by motion-activated camera, July 7, 2024)

(*Gavia immer*), bufflehead (*Bucephala albeola*), and cinnamon teal (*Anas cyanoptera*) were observed in April when water levels were high.

Topopah Spring (#8) had the most images (10,064; 11 mammals, 9 birds) with 9,542 images of chukar (*Alectoris chukar*) and 4 images of a spotted skunk (*Spilogales gracilis*; Figure 4-11) which was detected for the first time at this spring. Twin Spring (#16) had 7,722 images of 9 mammals and 10 birds with numerous images of feral burro (2,670 images), chukar (2,006 images) and mule deer (*Odocoileus hemionus*; 1,351 images) including several does, fawns and bucks. This is not surprising given the very hot, dry conditions and permanent water at this spring. A total of 256 images of pinyon jays (*Gymnorhinus cyanocephalus*) were also taken. A total of 6,296 images of 6 mammal and 7 bird species was recorded at Cottonwood Spring (#4). Most of the images were of feral burros (4,438) followed by chukar (730) and desert bighorn sheep (*Ovis canadensis nelsoni*; 700). Captain Jack Spring (#10) had 617 images of 7 mammals and 6 birds dominated by mourning dove (*Zenaida macroura*) (230), chukar (189), and mule deer (120). A predation event of a Cooper's hawk (*Accipiter cooperi*) attacking a chukar was captured by the camera and is shown in Figure 4-12. At Cane Spring (#7) 95 images of 5 mammals and 2 birds were taken mostly of desert cottontail rabbit (*Sylvilagus audubonii*; 43 images).

A total of 453 images were taken (4 mammals, 5 birds, 1 butterfly) at Fortymile Canyon Tanks (#9) dominated by mourning dove (260 images) and chukar (75 images). Delirium Canyon Tanks (#5) had 163 images of 6 mammals and 2 birds dominated by mourning dove (133 images). South Pah Canyon Tanks (#11) had 121 images of 8 mammals and 4 birds. Mourning dove (29 images), gray fox (*Urocyon cinereoargenteus*; 25 images), chukar (24 images), and rock wren (*Salpinctes obsoletus*; 22 images) were the main species detected. Notably, five images of spotted skunk were recorded. A total of 86 images (4 mammals, 3 birds) were taken at Rock Valley Tank (#2), dominated by coyote (71 images).

Figure 4-11. First record of a spotted skunk at Topopah Spring (#8).

(Photo by motion-activated camera, September 25, 2024)

Figure 4-12. A Cooper's hawk attacking a chukar at Captain Jack Spring (#10).

(Photo by motion-activated camera, September 14, 2024)

4.6 Constructed Water Source Monitoring

Four constructed water sources were monitored with motion-activated cameras to document the presence of mountain lions and other wildlife during 2024. These included one well pond (Camp 17 Pond), two water troughs installed to mitigate the loss of well ponds, and one radiologically-contaminated sump (Figure 4-13).

A total of 44 species (8 mammals, 34 birds, 2 invertebrates) were detected at Camp 17 Pond (#6) in 3,337 images (Table 6-6). Turkey vulture (*Cathartes aura*; 728 images) and red-tailed hawk (721 images) were the dominant species followed by common raven (*Corvus corax*; 347 images), feral horse (345 images), chukar (335 images), and mule deer (275 images). Notably, 18 images of peregrine falcon (*Falco peregrinus*; Figure 4-14), 14 images of common Blackhawk, and 12 images of white-faced ibis (*Plegadis chihi*) were photographed.

4.6.1 Mitigating Water Loss for Wildlife

Water conservation measures were implemented on the NNSS in 2012 at four sites: Area 6 Construction Yard (Area 6 LANL Pond), Well C1 Pond, Well 5B Pond, and J11 Pond. To conserve millions of gallons of water being lost to drainage and evaporation, pumping water to fill these ponds was stopped. Wildlife observation data gathered over several decades documented more than 100 species of wildlife using these artificial water sources. These included carnivores, ungulates, rabbits, bats, and dozens of species of waterfowl, passerines, and other birds. The drying of these ponds resulted in the loss of valuable wildlife habitat, so water troughs were installed to help mitigate the loss. The water troughs were not meant to replace the well ponds as wildlife habitat, but were meant to provide, at a minimum, some supplemental water in areas with very limited perennial water sources and at sites where animals had become accustomed to finding water.

Water troughs were installed adjacent to the Area 6 LANL Pond (Area 6 Construction Yard) and Well C1 Pond to mitigate the loss of these ponds, at Well 5A (Well 5C) to mitigate the loss of the Well 5B Pond, and at Cane Spring and Topopah Spring to mitigate the loss of the J11 Pond in Area 25. Motion-activated cameras were set up at each trough during the fall of 2012 and have been monitored since then to document wildlife use. These cameras were also added to the network of cameras used for monitoring mountain lions and results for 2024 are included in Table 6-6 (see Section 6.11.1, Motion-Activated Cameras). Wildlife use with motion-activated cameras at Well C1 Trough, Area 6 LANL Trough, and Cane Spring Trough was discontinued after 2023 for a variety of reasons including light use, lack of water, or additional water away from trough from fillstand overflow.

Wildlife use at Well 5C trough (#3) was heavy with 2,456 images of 9 mammals and 14 birds. Mourning doves accounted for the greatest number of images (707) followed by black-tailed jackrabbit (549) and pronghorn antelope (500). Kit fox (12 images) and badger (10 images) were also recorded. Wildlife use at Topopah Spring Trough (#23) was moderate with 423 images of 7 mammals and 7 birds. Chukar was the dominant species photographed (348 images).

In summary, several wildlife species use the water troughs, indicating the troughs are benefiting many wildlife species on the NNSS, especially certain bird species, ungulates, and coyotes. Waterfowl and shorebirds do not appear to use the troughs and undoubtedly have been negatively impacted by the removal of the well ponds. Although the water troughs did not replace the well ponds as a wildlife resource, they still attract and benefit a multitude of wildlife species, especially during the hot, dry summer.

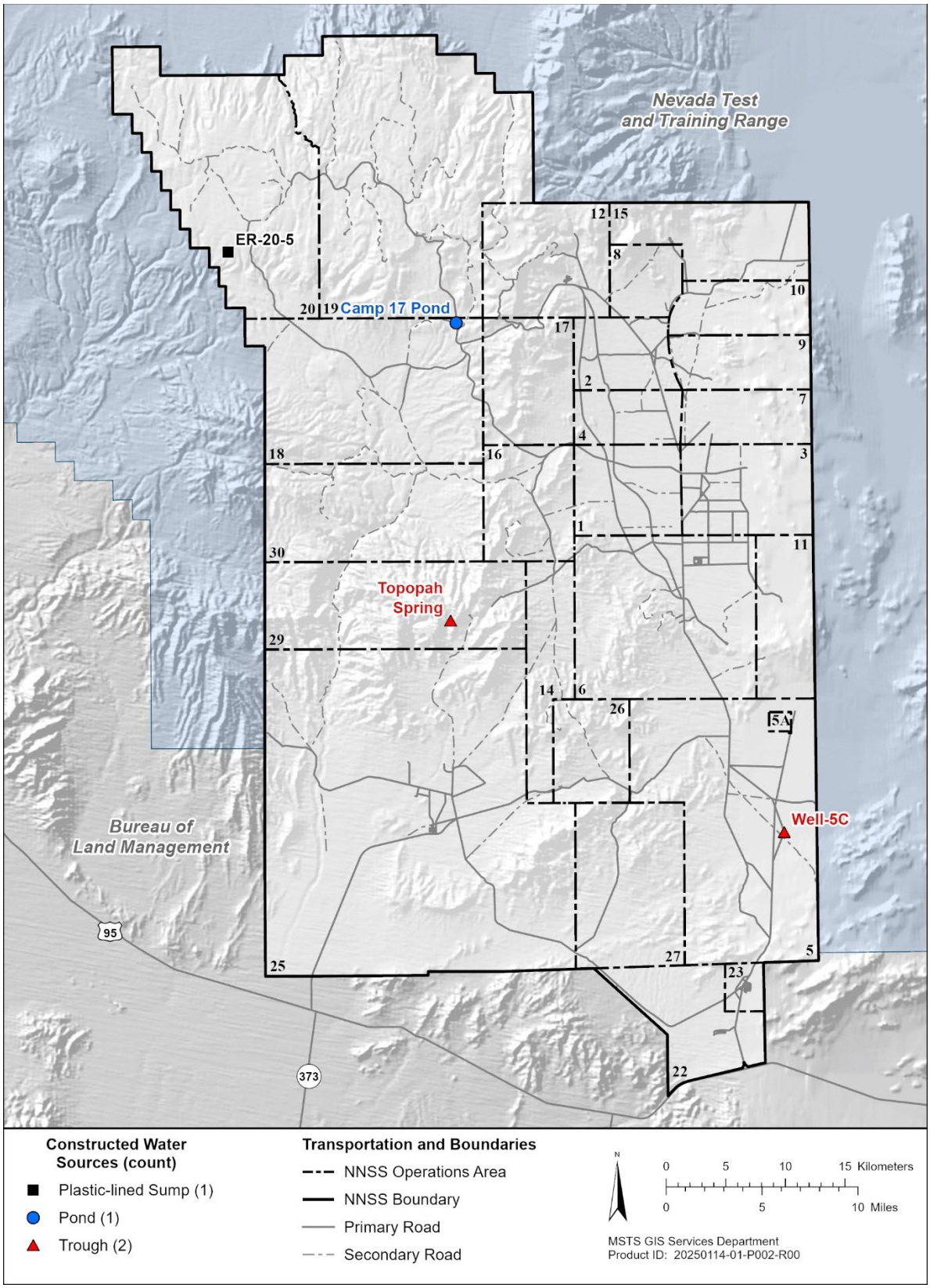

Figure 4-13. Constructed water sources monitored with motion-activated cameras for wildlife use during 2024.

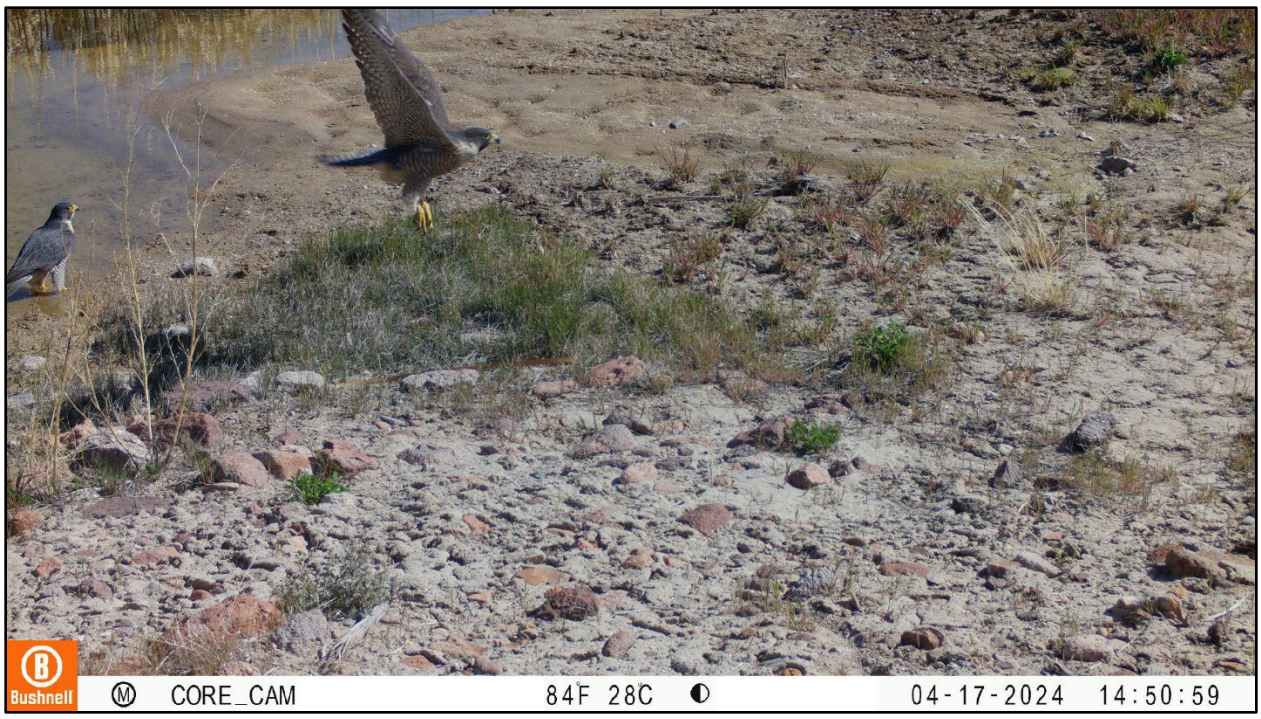

Figure 4-14. Two peregrine falcons at Camp 17 Pond (#6).

(Photo by motion-activated camera, April 17, 2024)

4.6.2 Monitoring Wildlife Use at Potentially Contaminated Water Sources

During 2024, a motion-activated camera was set up at one contaminated water source which is a sump constructed to retain groundwater and drilling fluids from Underground Test Area (UGTA) wells during drilling, well development, and groundwater testing. The sump was Environmental Restoration (ER) 20-5 (#12) (Figure 4-13). This camera was also added to the network of cameras used for mountain lion monitoring (see Section 6.11.1, Motion-Activated Cameras) (Table 6-6). Typically, discharge water and drilling fluids having ≥400,000 picocuries/liter of tritium are diverted to plastic-lined sumps to evaporate; otherwise, they are diverted to unlined sumps. Inactive well sumps can also retain precipitation, which can become contaminated from accumulated sediments. The camera was set up to document which wildlife species were using the sump and their frequency of use to assess the potential off-site transport of radionuclides by wildlife as well as the potential impact to the wildlife themselves.

Wildlife use at ER 20-5 (#17) was moderate with 124 images of 2 mammals and 9 birds taken. Common raven was recorded the most (81 images). Although use was infrequent the detection of mule deer (1 image), unknown duck species (25 images), mourning dove (3 images) golden eagle (1 image), red-tailed hawk (2 images), and turkey vulture (2 images) are of interest.

Important species are using this site and are potentially up-taking radiological contaminants. Game species and protected birds such as mule deer, mourning doves and multiple raptor species may also be impacted. Contaminated water sources will continue to be monitored to determine their level of use by various wildlife species, calculate the potential dose someone eating contaminated wildlife may receive, and determine if the dose is harmful to the animal. More information about potential dose to humans and wildlife can be found in the annual Nevada National Security Site Environmental Reports (e.g., MSTS 2024) available at https://nnss.gov/publication-library/environmental-publications/.

4.7 Coordination with Scientists and Ecosystem Management Agencies

NNSS biologists interfaced with other scientists and ecosystem management agencies in 2024 for the following activities:

- Participated in multiple conference calls for the Mojave Native Plant and Seeds of Success Program and the DOE Invasive Species Working Group.
- Participated in a meeting with the Eastern Mojave Wildlife Working Group.
- Assisted U.S. Forest Service personnel in monitoring long-term plots as part of the Forest Health Monitoring and Forest Inventory Analysis programs.
- Attended a workshop where updates were given on various projects associated with the Clark County Multiple Species Habitat Conservation Plan.
- By invitation, presented on plant and animal monitoring on the NNSS at the annual Native American Tribal Update Meeting.

5.0 SENSITIVE AND PROTECTED/REGULATED PLANT MONITORING

The list of sensitive and protected/regulated plants on the NNSS (see Table 2-1) is reviewed annually to ensure the appropriate species are included in the NNSS sensitive plant monitoring program. The working list of over 850 plant species identified on the NNSS is reviewed alongside the NDNH At-Risk Plant and Animal Tracking List (NDNH List). In 2024, the NDNH combined their Tracking and Watch Lists, greatly expanding the number of plants on the NDNH List. The Watch List was a list of known rare plant species which needed additional information to map distributions and identify status, whereas the Tracking List contained species and their distributions that were actively being evaluated and mapped. The plants actively being tracked by the NDNH increased from 286 to 633. Twenty-four plants that occur on the NNSS were added to the NDNH List, with one plant that has been of conservation concern on the NNSS since 1977, Kingston Mountains bedstraw (*Galium hilendiae* ssp. *kingstonense*), removed possibly due to taxonomic reasons. No changes will be made to the NNSS sensitive plant monitoring program until each species is evaluated for its status on the NNSS, in Nevada, and in other states.

Currently there are 19 vascular plants and one non-vascular plant considered sensitive and warrant inclusion in the NNSS sensitive plant monitoring program (see Table 2-1). Sensitive plant fact sheets were updated and posted for public viewing for each sensitive vascular plant: https://nnss.gov/mission/environmental-programs/plants-and-animals-2/sensitive-plants/.

5.1 Species Evaluations

5.1.1 White-margined beardtongue (*Penstemon albomarginatus*)

White-margined beardtongue is a perennial subshrub with showy lavender to pink tubular flowers with oblanceolate leaves that have white-colored margins (Figure 5-1). The plant is currently known from four populations: Pisgah Crater California, Dutch Flat Arizona, Clark County Nevada, and Nye County Nevada (Miller 2021). The plant has no current federal status, but is a State of California Endangered species, State of Arizona Critically Imperiled species, and on the NDNH List (Miller 2021). During the Nevada Rare Plant Workshop in 2007, the NDNH and Nevada Native Plant Society (NNPS) recommended the species be protected under State listing NAC 527 (NAC 2025b) citing threats to the Clark County population from proximity to airport development, land use changes, solar development, off highway vehicle use, and mining. Off highway vehicle use, land development, urban development, transmission lines, cattle grazing, and road maintenance are cited as the greatest threats to the species (Miller 2021).

Surveys on the NNSS were conducted from 1992-1994 (Blomquist et al. 1995) and in 2010 (Hansen et al. 2011). The plant has not been found on the NNSS but does grow approximately one kilometer south of Area 25 in deep, sandy soils on public land managed by the BLM. Hansen et al. (2011) explained “the soils found in the region of the NNSS are not the typical sandy soils that this species prefers” and recommended future surveys focus on the south-facing slope of Little Skull Mountain, otherwise “it is unlikely to be found anywhere else on the NNSS.”

In March 2023, the Center for Biological Diversity petitioned the FWS to list the species as threatened or endangered under the ESA (Center for Biological Diversity 2023). In January 2024, the FWS published their 90-Day Finding in the Federal Register stating the petition for protection of the species “present substantial scientific or commercial information indicating that the petitioned actions may be warranted” (FWS 2024). A 12-month status review of the species began and included a call for scientific data. Although the species is not known to grow on the NNSS, implications of federally protecting the species

could include protecting critical habitat, which could extend onto the NNSS. NNSS biologists will track the protection status and provide any requested data to aid protection of the species and its habitat.

5.2 Long-Term Monitoring

As part of the Adaptive Management Plan for Sensitive Plant Species (Bechtel Nevada 2001), the status of each sensitive plant is monitored periodically. Field surveys are conducted to verify previously reported locations, better define population boundaries, and identify existing or potential threats to populations. This year, sensitive plant fact sheets were updated and published on NNSS.gov to share information on distribution, threats, and uniqueness of the vascular plants in the NNSS's sensitive

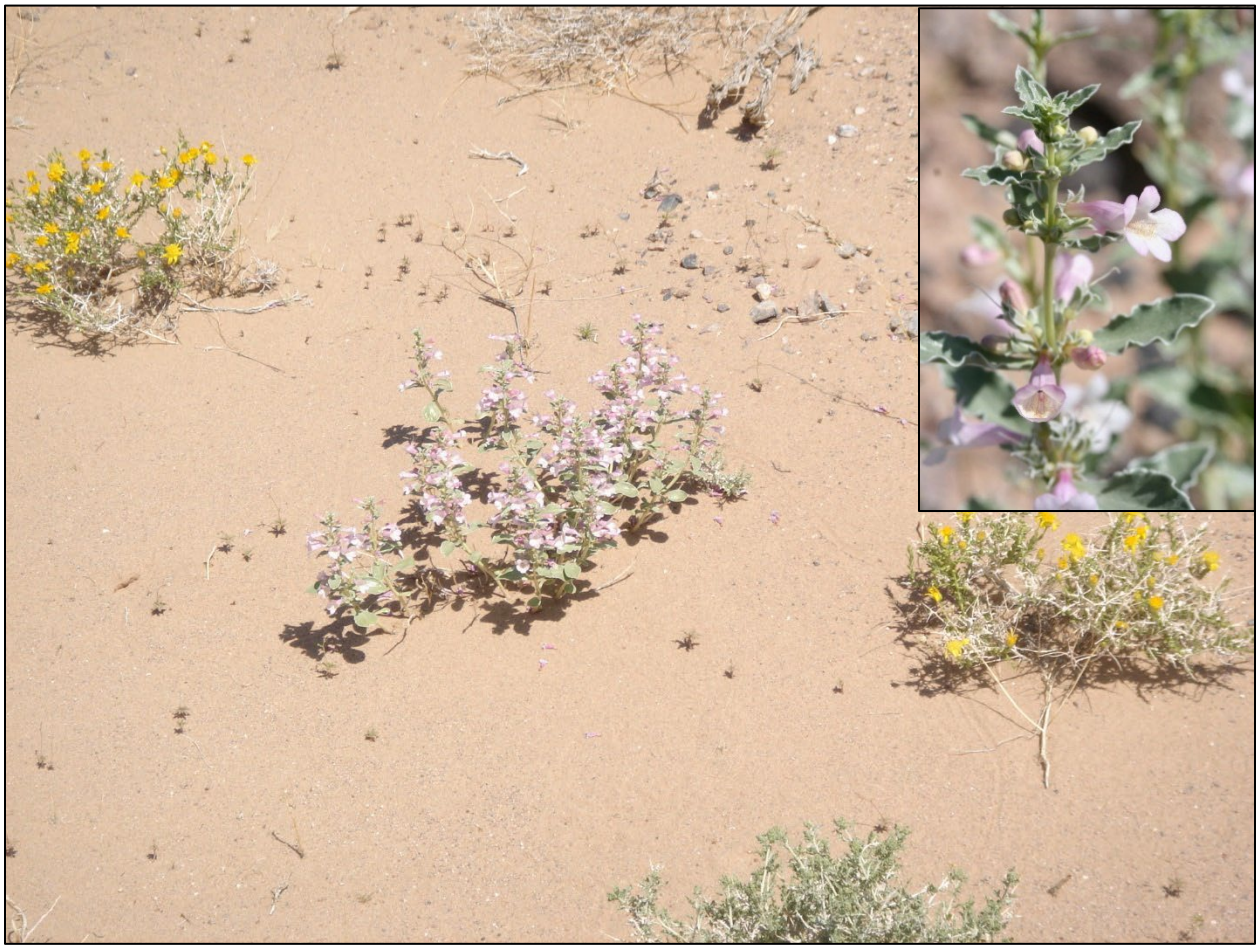

Figure 5-1. White-margined beard tongue flowers and leaves (inset) and its habitat.

(Photos by W.K. Ostler, April 19, 2010)

plant monitoring program (https://nnss.gov/mission/environmental-programs/plants-and-animals-2/sensitive-plants/). Long-term monitoring was scheduled for White bearpoppy (*Arctomecon merriamii*) and opportunistic encounters of two new populations of Sanicle biscuitroot (*Cymopterus ripleyi* variety [var.] *saniculoides*) occurred. A post-fire survey was conducted for Beatley's milkvetch (*Astragalus beatleyae*) in association with the Ribbon Cliff Fire.

5.2.1 Beatley's milkvetch (*Astragalus beatleyae*)

Beatley's milkvetch is a small, short-lived perennial herb which forms circular mats which bloom April through mid-July. Endemic to Nye County in Nevada, it has only been found on the NNSS and Nevada Test and Training Range (NTTR). Its type locality is on Pahute Mesa (UTM NAD83 545651 meters Easting [mE], 4126312 meters Northing [mN]) in an area designated in 1986 as critical habitat. Due to the extensive monitoring and research on the plant from the 1970's through 2000's, as well as the moratorium on underground nuclear testing, the plant is currently not designated as requiring protection under federal or state law. It is currently included in the NNSS's sensitive plant monitoring program as a high priority species.

The Ribbon Cliff Fire (see sections 4.1.1 and 4.1.2) started on the NTTR and burned through Area 20 on Pahute Mesa on the NNSS from August 22-24, 2024 (Figure 5-2). A post-burn ecological survey was

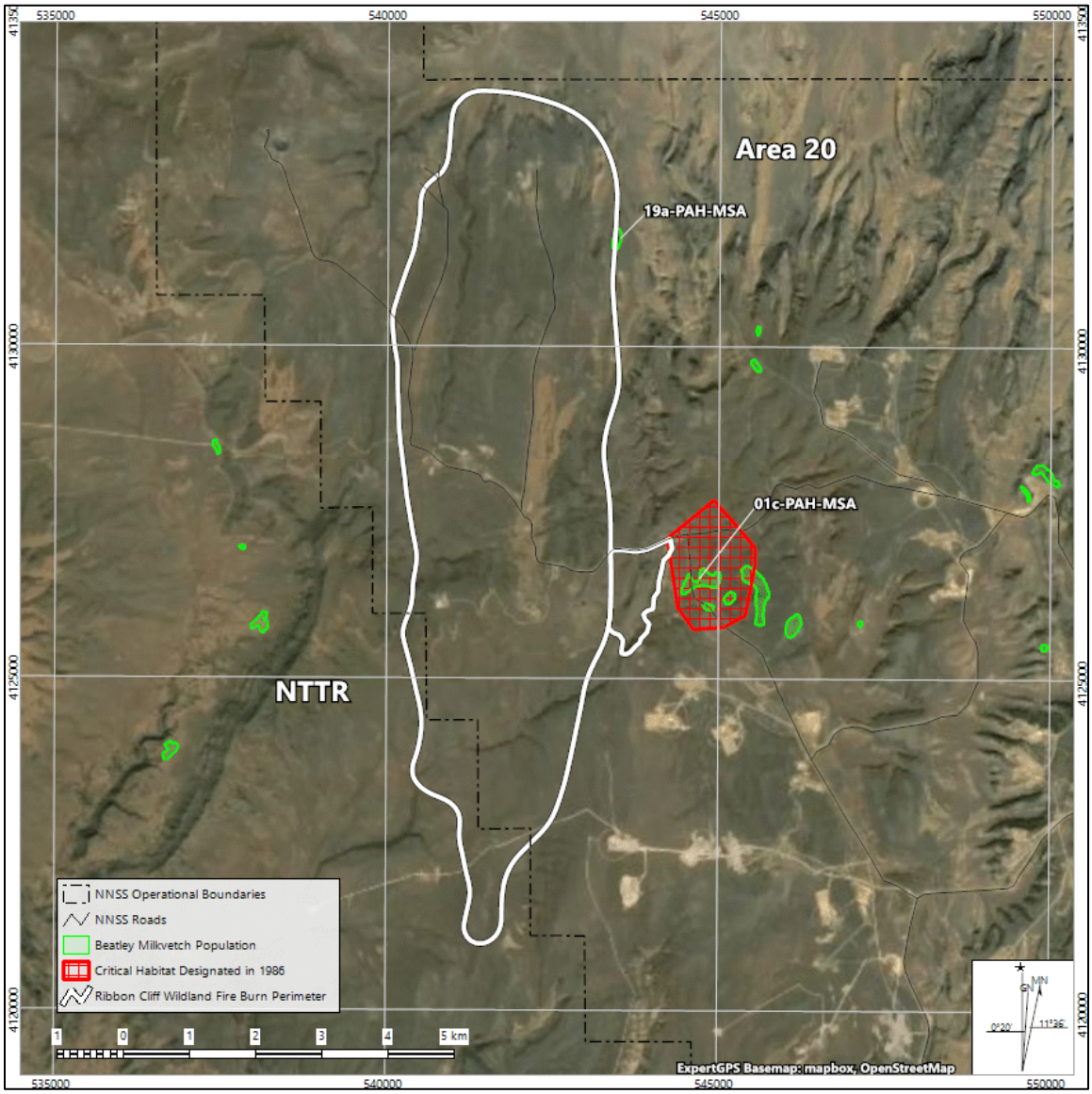

Figure 5-2. Ribbon Cliff Fire burn area near Beatley's milkvetch populations. Coordinates in UTM NAD83 (Zone 11, meters).

conducted on September 25, 2024. The fire burned near one Beatley's milkvetch population on Trail Ridge (19a-PAH-MSA) and firefighting activities came close to one of the type locality populations (01c-PAH-MSA) (Figure 5-2). The type locality, which is just south of the intersection of Pahute Mesa Road and the 20-01 Road, was not impacted by the fire. Firefighting activities associated with the burn came near but did not impact the population. A prescribed backburn along Pahute Mesa Road relating to the Ribbon Cliff Fire flare up stopped at the northwestern corner of known Beatley's milkvetch population 01c-PAH-MSA (UTM NAD83 544802mE, 4126456mN). A bulldozer line began at this location as well but did not go through any of the known populations. The Area of Critical Habitat designated in 1986 at the type locality was not impacted (Figure 5-2). The Ribbon Cliff Fire began burning into the Trail Ridge known population 19a-PAH-MSA (UTM NAD83 543455mE, 4131618mN) but fortunately was contained by the steep slope on the western edge of the plant population (Figure 5-3). Beatley's milkvetch habitat is found on top of the plateau, which was not impacted. These Beatley's milkvetch populations will be monitored post-burn, but impacts are not anticipated. Although the areas within the Ribbon Cliff Fire burn perimeter in Area 20 have been intensely surveyed for the plant, it is possible there is Beatley's milkvetch habitat within the burned area that has not been identified. As biologists monitor the area post-burn, any newly identified populations of the plant will be documented, added to the NNSS's sensitive plant monitoring program, and monitored for burn impacts.

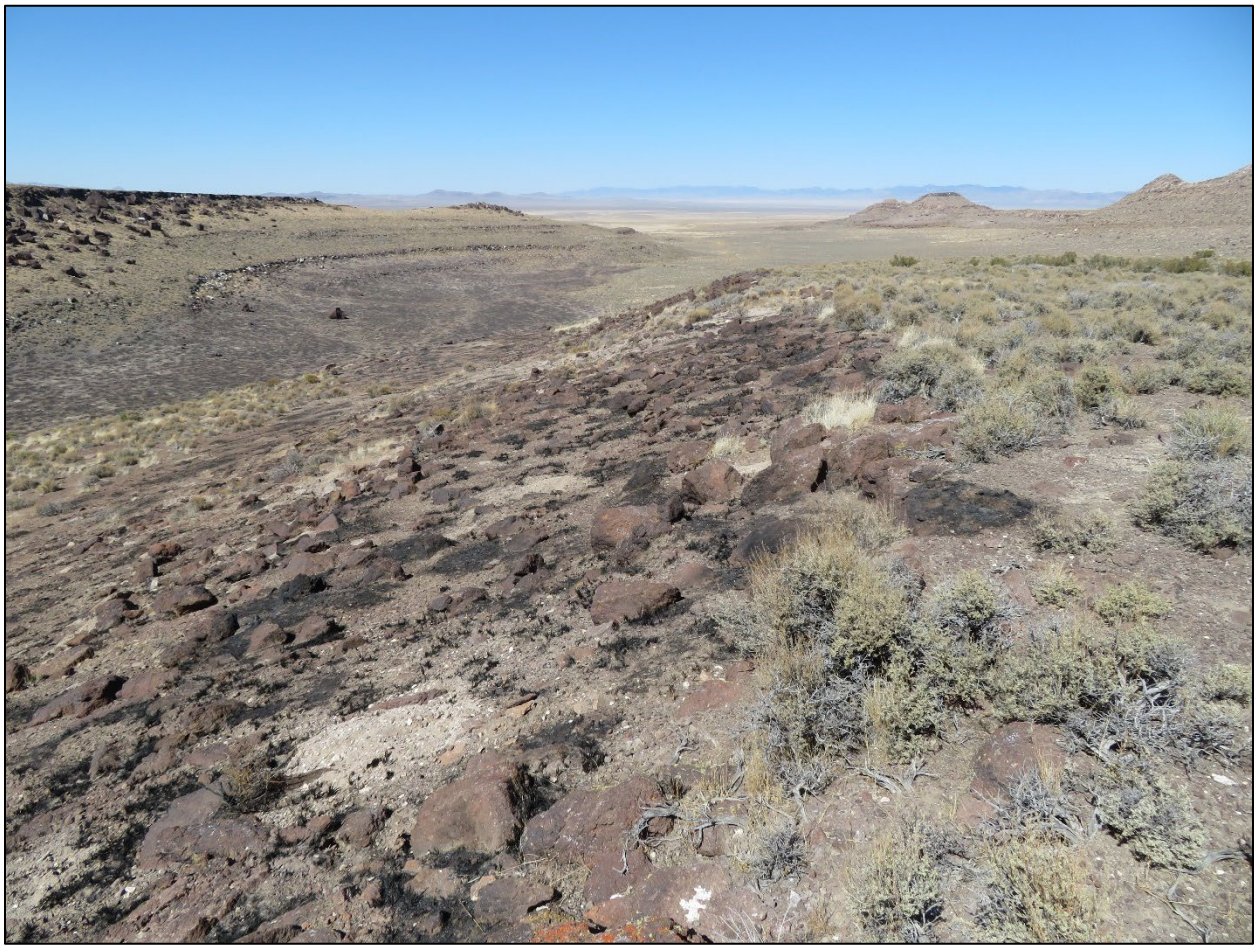

Figure 5-3. Burned habitat along the steep, western slope (left side) and intact Beatley's milkvetch habitat on top of the plateau (right side).

(Photo by D.B. Hall, September 25, 2024)

5.2.2 Sanicle biscuitroot (*Cymopterus ripleyi* var. *saniculoides*)

There are two varieties of Sanicle biscuitroot that occur on the NNSS; *Cymopterus ripleyi* var. *saniculoides* listed on the NDNH List and *C. ripleyi* var. *ripleyi* (Ripley's cymopterus), a more widely distributed species not considered at-risk. *C. ripleyi* var. *saniculoides* has purple flowers and grows along drainages in sandy washes at lower elevations on the NNSS. *C. ripleyi* var. *ripleyi* has white flowers and grows "along sandy slopes, or in shrub interspaces, with no apparent affinity for washes or drainages" at higher elevations on the NNSS (Hansen et al. 2010). Both plants are frequently encountered during surveys or while conducting other work.

Two new locations of Sanicle biscuitroot were opportunistically documented this year. The species is widely distributed throughout the Rock Valley area in sandy washes with new locations and population expansions documented nearly every year. The two new locations were in Rock Valley:

- New location: UTM NAD83 579439mE, 4062401mN
- New location: UTM NAD83 579988mE, 4061658mN

5.2.3 White Bearpoppy (*Arctomecon merriamii*)

White bearpoppy is found throughout Mercury Ridge, Red Mountain, and Mercury Township on the NNSS. Its bluish-green foliage covered with long, silvery, pilose hairs and white, showy flowers inclined to nod in bud on long (20–30 cm), naked stems can be easily spotted during its bloom period. *Arctomecon* species in their first year will only grow leaves and will flower in their second year (Thompson and Smith 1997). They can live several years after initial flowering, with multiple flowering events (Thompson and Smith 1997). There are three species of *Arctomecon* with different distributions and statuses:

- *Arctomecon merriamii* – Nevada (NDNH List), California (rare or endangered)
- *Arctomecon californica* – Nevada (critically endangered), Arizona (special status species); largest of the genus, yellow flowers
- *Arctomecon humilis* – Utah (endangered under the ESA); smallest of the genus, white flowers

Eleven locations of white bearpoppy located around Mercury and Mercury Ridge were visited in early May 2024 (Figure 5-4). Healthy plant populations were found at all locations except two: 04a-MER-TWN and 04d-MER-TWN (Figure 5-4). The two locations where plants were not found may be extirpated or extinct. Plants have not been found at 04a-MER-TWN since 1994. Water tanks were constructed at this location prior to the 1980s. The area is prone to disturbance from road and water tank maintenance. Plants have not been found at 04d-MER-TWN since 2012 when 200 plants were observed, with the earliest observation in 1994 of just one plant. It is possible this population has gone extinct. At the nine locations where plants were observed, there were over 1,200 plants with small population expansions at four of the locations (i.e., plants were found outside the previously mapped population area) (Figure 5-5). One new location was identified on Mercury Ridge and added to the NNSS's database (06b-MER-RDG) (Figure 5-4). Several populations around Mercury were visited for the second year in a row by researchers from Utah State University conducting research on the Mojave poppy bee (*Perdita meconis*) (see Section 6.3).

5.3 Coordination with Other Scientists

- NNSS biologists participated in the Joshua Tree Biological Working Group. The group is comprised of several government agencies committed to align research, monitoring, and management goals to protect and collect long-term data on Joshua trees. An NNSS biologist

participated in the wildfire subgroup which focuses on the impacts of fires in Joshua tree habitat, proliferation of wildfire from cheatgrass invasions, and recovery of habitat post-burn.

- An NNSS biologist attended the Nevada Rare Plant Workshop October 3-5 hosted by the NNPS and NDNH in Las Vegas, Nevada. The workshop invites public- and private-sector botanical experts and resource professionals from throughout the west to gather and discuss current and new information, hear in-depth presentations on current research and projects, and review and recommend conservation priorities for Nevada's rarest plant species. The NNPS status list and other agency status assignments are reviewed and, when necessary, changed at this workshop for plant taxa of concern to the group. Status changes and recommendations are made only with the consensus of all participants.

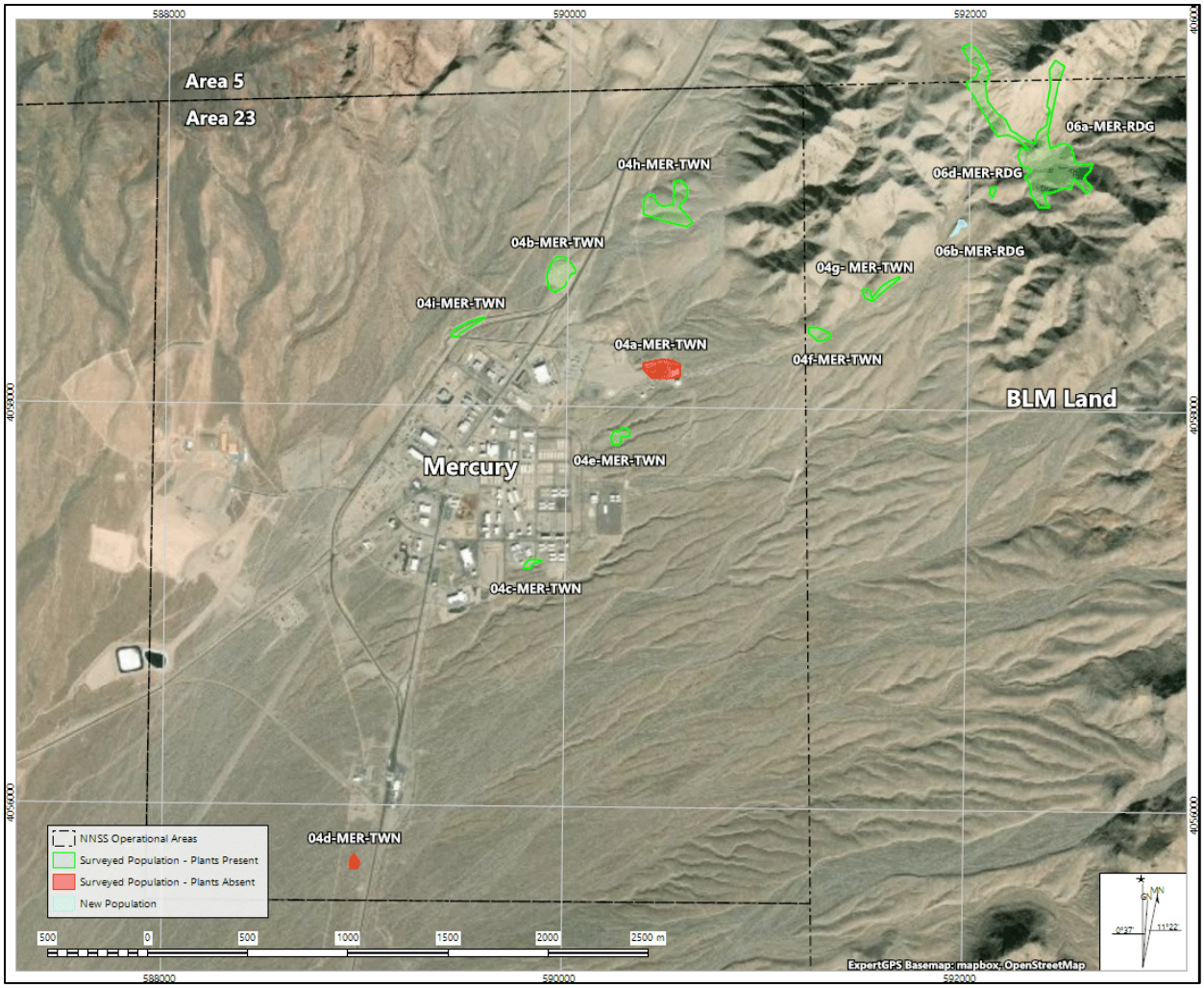

Figure 5-4. White bearpoppy populations surveyed in 2024 around Mercury. Coordinates in UTM NAD83 (Zone 11, meters).

Figure 5-5. White bearpoppy plants at population 06a-MER-RDG.

(Photo by J.A. Hannon, May 7, 2024)

- An NNSS biologist sat on the NNPS board and attended meetings that occurred virtually by combining the Northern and Southern Chapters. The Southern Chapter met for a field trip on November 16 at a future utility-scale solar facility site approximately 10 km south of the NNSS to discuss protection of cacti and yucca species.

- An NNSS biologist attended meetings for the Ahart Herbarium hosted by California State University Chico for their "All Things Botanically Related" series which focused on pollinator health in 2024.

- NNSS biologists are working with the webhost for the Intermountain Region Herbarium Network to include images of all plant specimens housed in the NNSS herbarium. The website (https://intermountainbiota.org/portal/collections/index.php?catid=1) includes all cataloged plant specimens from the NNSS herbarium and is open for public use. NNSS biologists are working to digitize over 7,000 specimens.

6.0 SENSITIVE AND PROTECTED/REGULATED ANIMAL MONITORING

The NDNH At-Risk Plant and Animal Tracking List (NDNH 2025); NAC 503, "Hunting, Fishing and Trapping; Miscellaneous Protective Measures" (NAC 2025); FWS Endangered Species home page (FWS 2025); and other sources were reviewed to determine if any changes had been made to the status of animal species known to occur on the NNSS. The sage sparrow (*Amphispiza belli*) was removed from the sensitive species list and the sagebrush sparrow (*Artemisiospiza nevadensis*) was added after being separated into two separate species (sagebrush sparrow and Bell's sparrow [*Artemisiospiza belli*]). Bell's sparrow appears to occur further west into Calfornia with sagebrush sparrow the most likely species on the NNSS but it is possible that both species may occur. Future surveys are planned to verify this assumption. The northern goshawk (*Accipiter gentilis*) was split into two species including American goshawk (*Astur atricapillus*) and Eurasian goshawk (*Astur gentilis*). The little brown bat (*Myotis lucifugus*) was added to the list after a confirmed acoustic call was detected at Twin Spring making a total of 16 bat species known to occur on the NNSS. The complete list with current designations is found in the Sensitive and Protected/Regulated Animal Species List (Table 2-1).

Surveys of sensitive and protected/regulated animals during 2024 focused on (a) Mojave poppy bee, (b) birds, (c) bats, (d) feral horses, (e) mule deer, (f) pronghorn antelope, (g) desert bighorn sheep, and (h) mountain lions. Information about the monarch butterfly, Mercury weevil (*Miloderes mercuryensis*), other noteworthy wildlife observations, bird mortalities, and a summary of nuisance animals and their control on the NNSS is also presented.

6.1 Mercury Weevil

The Mercury weevil is categorized as G1 and S1 (critically imperiled) by NDNH due to its very small range and narrow habitat requirements. It was first found and described on the NNSS in 1964 (Tanner 1966). He reports that three specimens were collected on the NNSS: one from desert globemallow, Area 5, in June 1964; one from spiny hopsage, Area 26, in June 1965; and one from a pit-can trap on the Jackass Flats approach road in a mixed plant association within the creosote bush-white bursage plant community. He further states, "Holotype male in the U.S. National Museum. Two paratypes in the entomological collection at Brigham Young University." The weevil appears to be a sand dune obligate with limited dispersal ability. It is not currently protected by state or federal law. Nature Serve Explorer (2024) recommends that further surveys to determine presence and current distribution should be done and in contradiction to Tanner (1966) states, "There are only seven known specimens of this beetle. One at the type locality on the NNSS and six others in similar habitats further south in Clark County." (https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.1154618/Miloderes_mercuryensis, site accessed August 1, 2024). It is possible that the specimens from Clark County may be a different species, but further research is needed to verify this (Van Dam and O'Brien 2015).

On October 28, Corey Lange (BLM biologist) and an NNSS biologist conducted weevil surveys near the type locality in north Frenchman Flat. A few dead body parts of *Arinolus* sp. millipedes and the abdomen of what appears to be a *Miloderes* weevil were found. This would likely be the Mercury weevil but it could not be confirmed without a live specimen. Future surveys are planned to learn more about the distribution, taxonomy, and status of this species.

6.2 Monarch Butterfly

On December 12, 2024, FWS proposed to list the monarch butterfly as threatened under the ESA and designate critical habitat, all of which is in California. Public information meetings and hearings along

with a public comment period will be scheduled in 2025 before finalizing listing. This species has been documented at four locations on the NNSS ranging from low elevation creosote bush-white bursage habitat to higher elevation sagebrush habitat (Figure 6-1). Dates of sightings are mostly during the fall migration period; July 30, 1990, September 22, 2004, September 30, 2004, and October 10, 2023. Monarch caterpillars feed exclusively on milkweed plant leaves. Two species of milkweed, desert milkweed (*Asclepias erosa*) and Mexican whorled milkweed (*Asclepias fascicularis*), are known to occur on the NNSS in small, localized patches (Figure 6-1) so summer habitat for them is limited which may explain why most of the observations have been during the fall.

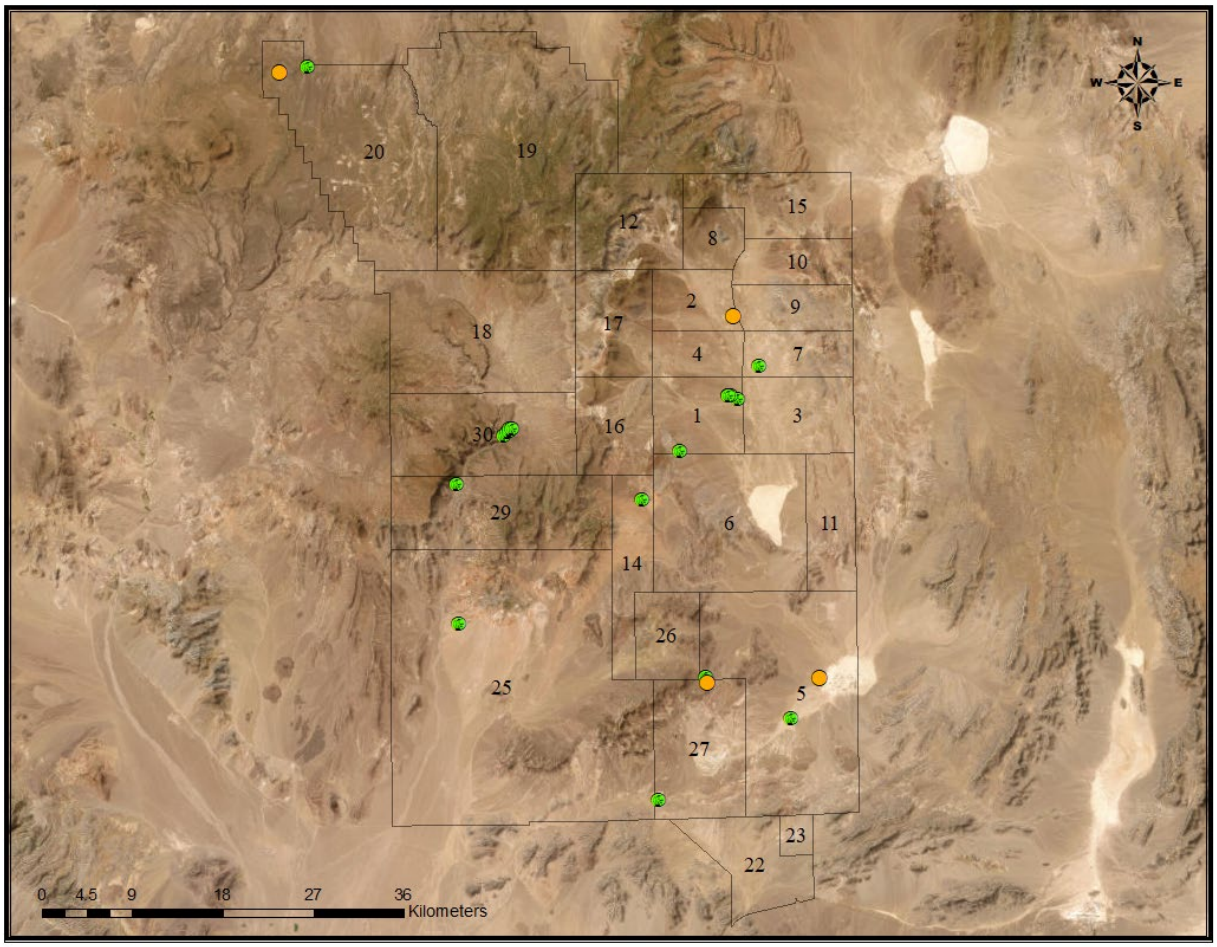

Figure 6-1. Known monarch butterfly (orange circles) and desert milkweed (green dots) locations on the NNSS. Numbers denote operational areas.

6.3 Mojave Poppy Bee

The Mojave poppy bee is a sensitive species that is under status review by the FWS to determine if it should be listed under the ESA. It is currently not known to occur on the NNSS but is likely to occur. It is primarily found on and is an important pollinator of *Arctomecon* and *Argemone* species including the white bearpoppy (see Section 5.2.3), a sensitive plant species found on the NNSS. Surveys for the bee were conducted in a collaborative effort with Dr. Terry Griswold and Ann Mull (Utah State University) for the second year in a row. Several populations of white bearpoppy and *Argemone* were sampled for insect visitors on May 22-23. No Mojave poppy bees were found. Identification of other collected insects is still pending from 2023 and 2024.

6.4 Birds

Bird monitoring on the NNSS during 2024 focused on Migratory Bird Treaty Act (MBTA) compliance, documenting bird mortalities, implementing the NNSS Avian Protection Plan (APP), conducting winter raptor surveys, initiating three breeding bird survey routes, and a western burrowing owl radio-tracking study.

6.4.1 Migratory Bird Treaty Act Compliance

The MBTA is a federal law designed to protect most bird species. All but six birds known to occur on the NNSS are protected under the MBTA. Exceptions include the European starling, English house sparrow, rock dove or pigeon, and the Eurasian collared dove. The chukar and Gambel's quail are also not protected under the MBTA but are regulated by Nevada state law as gamebirds.

U.S. Executive Order 13186 *Responsibilities of Federal Agencies to Protect Migratory Birds* (2001) directs federal agencies to develop a Memorandum of Understanding (MOU) and work with FWS to promote the conservation of migratory bird populations. An MOU was signed by DOE and FWS in September 2013 regarding implementation of U.S. Executive Order 13186 (2001). This MOU is currently being updated.

Actions taken to comply with the MBTA and MOU during 2024 included the following: 1) followed requirements in our two FWS permits pertaining to migratory birds, 2) conducted pre-activity surveys for proposed projects before surface-disturbing work or building demolitions to avoid harming birds or their nests, 3) found and protected six active nests from being disturbed, 4) moved two active nests from harm's way, 5) removed barn owl (*Tyto alba*) from underground facility, 6) removed two great-tailed grackles (*Quiscalus mexicanus*), two house finches (*Haemorhous mexicanus*) , a juvenile brown-headed cowbird (*Molothrus ater*), and a cactus wren (*Campylorhynchus brunneicapillus*) from glue traps and released them, 7) rescued a grounded pied-billed grebe (*Podilymbus podiceps*) and moved it to water so it could take off, and 8) implemented the NNSS APP.

6.4.2 Bird Mortalities

Bird mortality is a measure of impacts that NNSA/NFO activities may have on protected bird species. NNSA/NFO activities that have affected birds typically have been of two types: electrocution and vehicle mortalities. Other causes of death include predation, disease, and entrapment and in many instances the cause of death is unknown. Workers and biologists work together to observe and report mortalities. A total of 22 dead birds were documented on the NNSS in 2024 (Figure 6-2). One common raven was electrocuted. Five birds were hit by vehicles including one sharp-shinned hawk (*Accipiter striatus*), one immature red-tailed hawk, one barn owl, one common poorwill (*Phalaenoptilus nuttallii*), and one northern mockingbird (*Mimus polyglottos*). Four birds (two red-tailed hawks, one great-horned owl, and one northern mockingbird) died of entrapment. One European starling may have collided with a building and died but is included in the unknown category. Twelve birds were found dead due to unknown causes; the starling, two red-tailed hawks, a sharp-shinned hawk, a mourning dove, a lesser goldfinch (*Spinus psaltria*), a Say's phoebe (*Sayornia saya*), two common ravens, a Virginia rail (*Rallus limicola*), one northern mockingbird, and an ash-throated flycatcher (*Myiarchus cinerascens*). Some of these mortalities occurred during record-breaking heat and may have been caused by heat exposure.

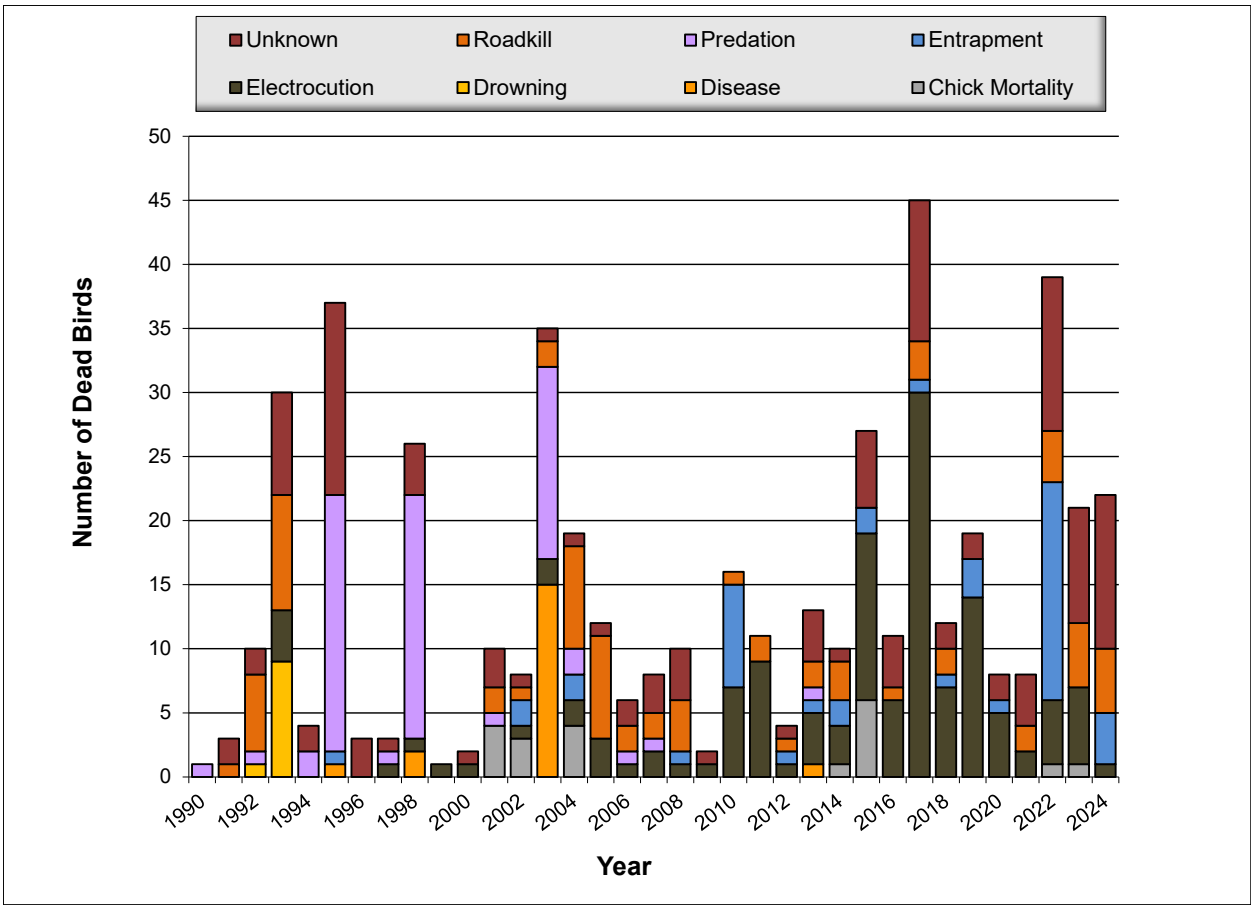

Figure 6-2. Records of reported bird deaths on the NNSS, 1990–2024.

6.4.3 Implementing the NNSS Avian Protection Plan

The NNSS APP was finalized during 2017. Its main purpose is to describe a program intended to reduce the operational and avian risks that result from avian interactions with electric transmission and distribution lines on the NNSS owned by NNSA/NFO as well as other non-electric sources of mortality (e.g., vehicle collisions, habitat disturbance).

At the end of each calendar year the APP is reviewed, and the following questions answered: 1) Is the reporting procedure effective at documenting avian mortalities, 2) Are reported mortalities/injuries addressed in a timely manner, 3) Are permit conditions being met, and 4) What mortality reduction measures were taken and are they effective. For 2024 answers to these questions are:

- The reporting procedure was effective at documenting avian mortalities. There is good communication between biologists, the power group, other NNSS workers, and the Operations Command Center to report avian issues. Biologists responded to 42 calls related to avian issues during 2024. This is not surprising because of the increased bird activity caused by above-normal winter-spring precipitation.

- Reported mortalities/injuries were addressed in a timely manner and were usually investigated the same day or within a few days.

- Currently, there are two federal permits and one state permit pertaining to birds on the NNSS. Federal permit MB008695-2 allows the taking of up to 10 mourning doves each year for radiological analysis and the salvage of dead migratory birds (except species listed under the ESA). All permit conditions were met and an annual report summarizing 2024 activities was submitted to FWS. No mourning doves were taken, and no bird specimens were salvaged for educational purposes. Federal permit MB60930C-1 is a "Special Purpose Utility Permit – Electric," and was issued November 6, 2018. This permit enables NNSS biologists to remove active nests at project sites in emergency situations and possess and transport carcasses of golden eagles and other bird species. On May 1, a sparrow nest containing five eggs was removed from a conveyor belt and placed in an old nest in a Joshua tree. The nest was checked the next day and it had been predated with no intact eggs remaining. FWS was notified. On May 16, a house finch nest containing five young was moved from an energized breaker panel to a new box. FWS was notified. Subsequent checks determined the nest was safe and the young fledged. All permit conditions were met and an annual report summarizing 2024 activities was submitted to FWS. This included entering all bird injuries and mortalities into the Injury and Mortality Reporting system, a FWS electronic database. NDOW Scientific Collection Permit 261454 allows for the salvage and possession of migratory birds and the sacrificing of mourning doves, chukar, and Gambel's quail. All permit conditions were met and an annual report summarizing 2024 activities was submitted to NDOW.

- Several mortality reduction measures were taken. Two great-tailed grackles, two house finches, a juvenile brown-headed cowbird, and a cactus wren were extracted from glue traps and released. A grounded pied-billed grebe was rescued and moved to water so it could take off. A total of 113 ha of habitat was surveyed at 22 project sites for active bird nests before disturbance. Finally, several dead rabbits and snakes were removed from roads to reduce the potential for vehicle mortalities of scavenging birds. These measures were effective at reducing avian mortalities. In fact, the number of electrocutions over the last few years appears to be declining (Figure 6-2), which may be due, at least in part, to the hundreds of power pole retrofits that have been completed during this timeframe.

6.4.4 Winter Raptor Surveys

Winter raptor surveys were initiated during 2014, to better understand wintering raptors on the NNSS and as a collaborative effort to provide data to the U.S. Army Corps of Engineers' nationwide mid-winter bald eagle survey and NDOW's statewide monitoring effort. Surveys continued in 2024 and were conducted by driving a standard route to identify all raptors observed (i.e., eagles, hawks, falcons, owls, and vultures). Two official routes were established on the NNSS: Southern NNSS, Route #60 (83 km), and Yucca Flat, Route #61 (75 km) (Figure 6-3). Data including common name, UTM coordinates (NAD83), time, activity, age class, and perpendicular distance from the road were recorded, and climatic data (i.e., temperature, wind speed, and cloud cover) were taken at the beginning and end of each survey. Surveys for Route #60 were conducted on January 23 and February 13, and surveys for Route #61 were conducted on January 24 and February 12.

These surveys are conducted each year to look at long-term trends in winter raptor occurrence on the NNSS. Much is known about raptors on the NNSS in the summer, but winter data are lacking. Winter data may be important to detect changes in species composition related to climate change. Data on common ravens and loggerhead shrikes (*Lanius ludovicianus*) were also recorded because ravens are known desert tortoise predators, and the loggerhead shrike is a sensitive species. The southern route (#60) is located primarily in the Mojave Desert portion of the NNSS while the Yucca Flat route (#61) is located in the transition zone between the Mojave Desert and Great Basin Desert. Detailed driving directions for each route are found in the 2016 EMAC report (Hall et al. 2017).

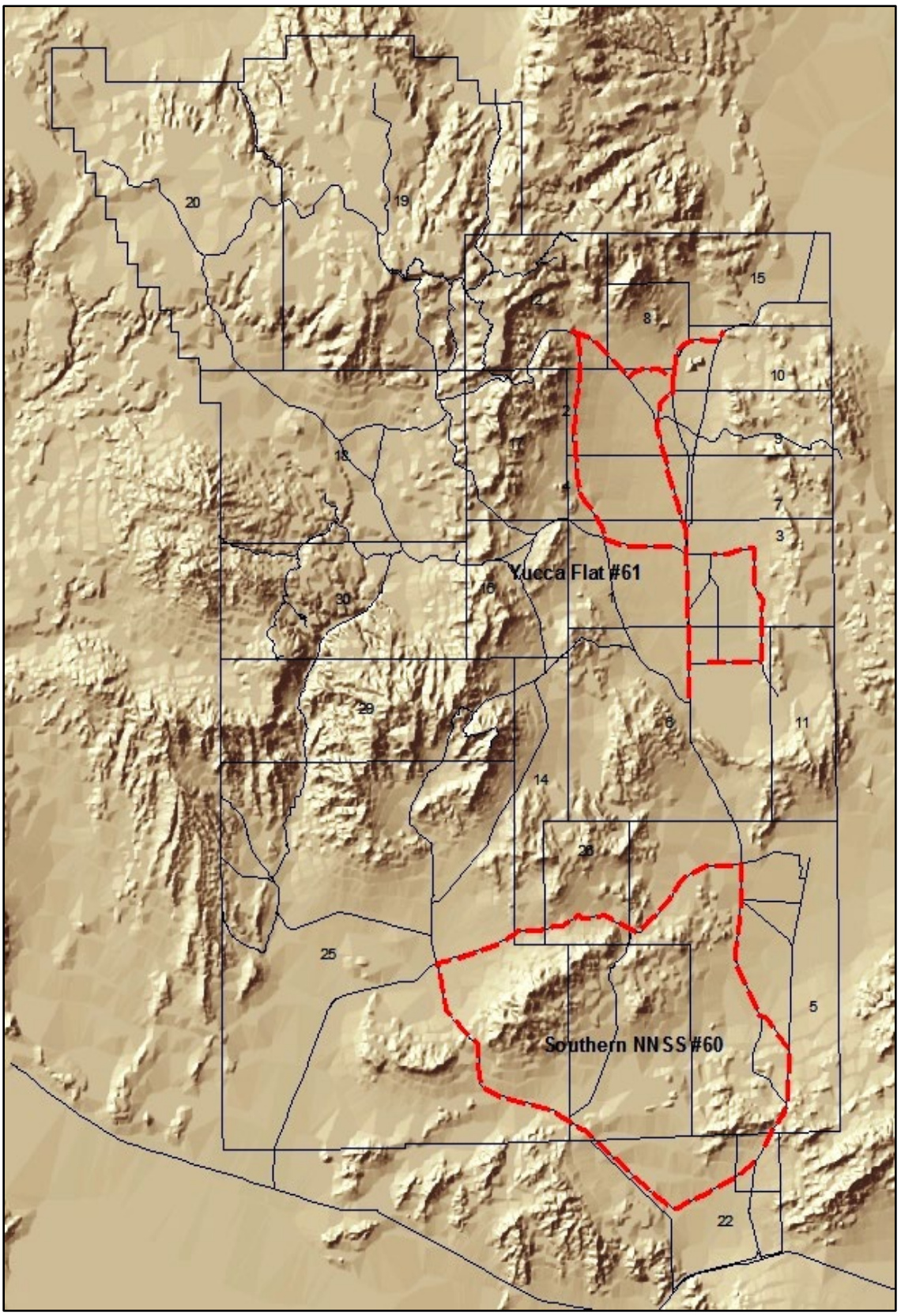

Figure 6-3. Winter raptor survey routes (red lines) on the NNSS.

Only one raptor species, a red-tailed hawk, was detected during both surveys on the southern route. Observations of three raptor species including 19 red-tailed hawk, 6 American kestrel (*Falco sparverius*), and 2 northern harrier (*Circus cyaneus*) observations were detected on the northern route (Table 6-1). Common ravens and loggerhead shrikes were more prevalent on the Yucca Flat route than on the southern route. Data were entered into the Ecological Geographic Information System (EGIS) faunal database and given to NDOW for inclusion in their analyses.

Table 6-1. Results (number of observations) of winter 2024 raptor surveys on the NNSS.

Species	Southern NNSS (1/23/24)	Southern NNSS (2/13/24)	Yucca Flat (1/24/24)	Yucca Flat (2/12/24)
Red-tailed Hawk	0	1	5	14
Northern Harrier	0	0	1	1
American Kestrel	0	0	3	3
Total Raptors	**0**	**1**	**9**	**18**
Common Raven	3	5	18	8
Loggerhead Shrike	0	1	6	1

6.4.5 New Breeding Bird Survey Routes

Bird survey routes were added to our monitoring efforts for 2024 in coordination with NDOW following the USGS protocol (Hudson et al. 2017) for breeding bird surveys (BBS). BBS are avian point count surveys throughout North America designed to comprehensively study bird populations and abundance using rigorous, standardized protocols. Three bird survey routes were established by NNSS biologists in each of the three major ecoregions on the NNSS (Figure 6-4). These include the NNSS South Route in the Mojave Desert (primarily creosote bush-white bursage vegetation), the NNSS Yucca Flat Route in the Transition ecoregion (primarily blackbrush and salt desert vegetation), and the NNSS North Route in the Great Basin Desert (primarily sagebrush-singleleaf pinyon pine-Utah juniper vegetation). These routes are surveyed annually during peak breeding bird season, which is typically in June for most of North America. Data collected from these surveys will help NNSS biologists track long-term bird population trends and will also be made publicly available. The intent was to add these new NNSS routes to the national network of BBS routes but USGS, the lead agency for BBS, is not adding any new routes.

Each route is 39.2 km long with 50 points evenly spread out every 800 m. Surveys were conducted by driving to and stopping at each point to record every bird heard and seen during a three-minute period. Routes were conducted by two biologists where one drove the entire route and recorded data while the other identified birds by sight and sound. The South Route was surveyed during May, where peak breeding season for birds occurs earlier than June due to the hotter, drier climate. The other two routes were surveyed in June. Data collected was entered into the EGIS faunal database.

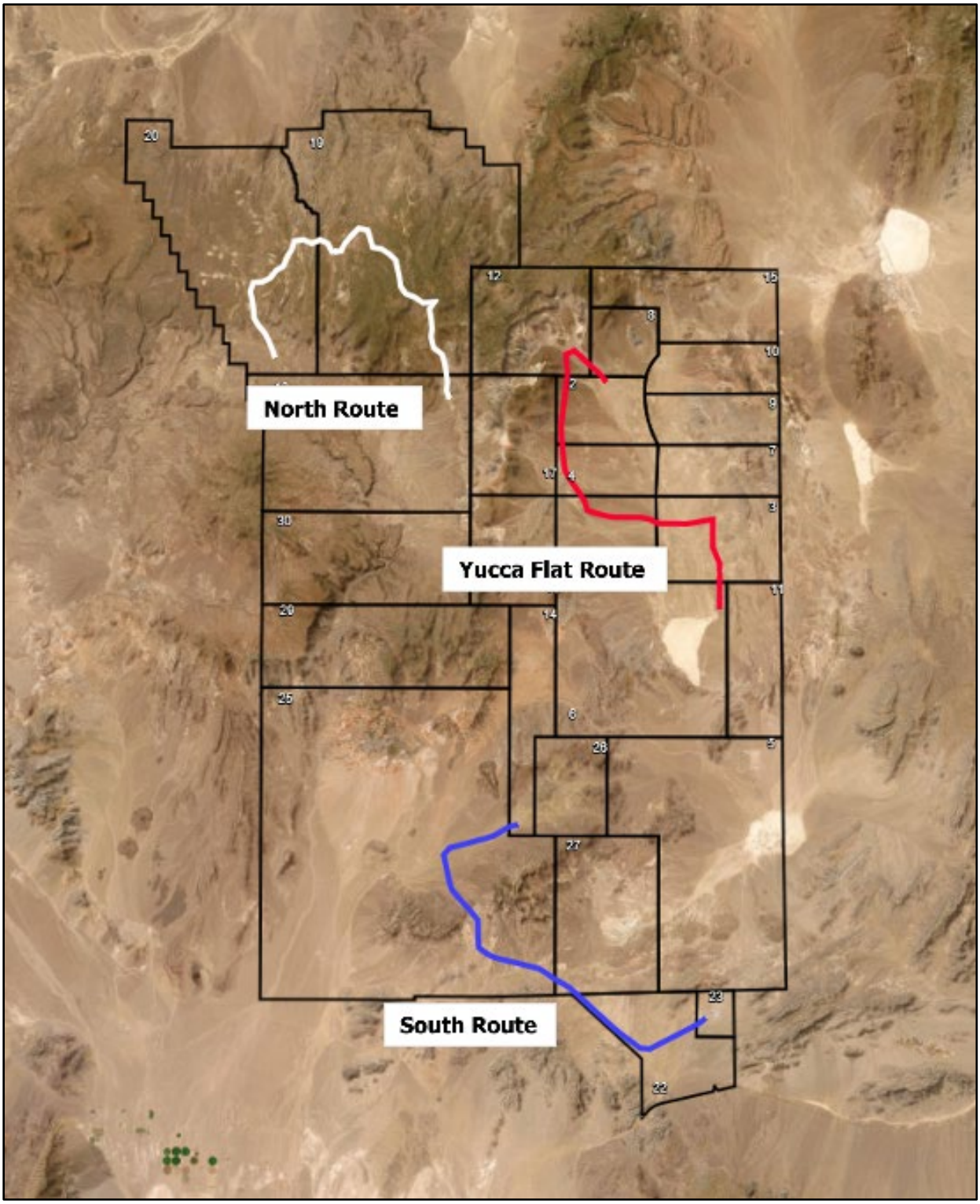

Figure 6-4. Location of three Breeding Bird Survey (BBS) routes created and surveyed during 2024.

A total of 33 different bird species and 566 bird detections were recorded during the surveys (Table 6-2). As expected, the North Route had the highest species richness (25 species) due to the higher quality habitat. Also expected was the greater species richness on the Yucca Flat Route (17 species) than on the South Route (11 species). Surprisingly, the Yucca Flat Route had the most bird detections, with 282 counted. Black-throated sparrow (*Amphispiza bilineata*) was the most common species (~33% of all birds counted), occurring on all routes. As expected, the South Route had the least number of birds due to the hotter, drier climate and less productive habitat than the other two routes. A noteworthy observation of 12 pinyon jays were counted on the North Route. Pinyon jays have been declining every year by 3–4% for at least the past 50 years (Boone et al. 2021). In April 2022, the pinyon jay was petitioned for listing under the ESA. In August 2023, FWS acknowledged the species may warrant ESA protection, but a formal determination has been significantly delayed. This is a species of concern that will be followed with interest during future surveys.

Table 6-2. Number of bird detections by species for three Breeding Bird Survey routes completed in 2024.

Species	North Route	Yucca Flat Route	South Route	Total
Ash-throated Flycatcher	4	25	6	35
Say's Phoebe	1	13	1	15
Northern Mockingbird	1	20	14	35
Black-throated Sparrow	33	74	79	186
Mourning Dove	2	28	6	36
Rock Wren	24	0	3	27
Red-tailed Hawk	0	4	1	5
Bushtit	7	0	0	7
House Finch	0	9	1	10
Horned Lark	0	48	8	56
Loggerhead Shrike	1	24	2	27
Western Wood-Pewee	1	0	0	1
Western Kingbird	0	14	0	14
Sage Thrasher	0	2	0	2
Blue-gray Gnatcatcher	10	1	0	11
Brown-headed Cowbird	1	0	0	1
Barn Owl	0	1	0	1
Lesser Nighthawk	0	1	0	1
Cactus Wren	0	1	0	1
Woodhouse's Scrub Jay	8	0	0	8
Pinyon Jay	12	0	0	12
Lazuli Bunting	1	0	0	1
Anna's Hummingbird	1	0	0	1
Green-tailed Towhee	2	0	0	2
Black-Throated Gray-Warbler	1	0	0	1
Hairy Woodpecker	1	0	0	1
Chipping Sparrow	4	0	0	4
Brewer's Sparrow	7	0	0	7
White-Crowned Sparrow	2	0	0	2
Spotted Towhee	32	0	0	32
Scott's Oriole	1	0	0	1
Western Meadowlark	4	1	0	5
Common Raven	1	16	1	18
Total Detections	162	282	122	566
Species Richness	25	17	11	33

6.4.6 Western Burrowing Owl Radio-tracking Study

The western burrowing owl is a National Species of Conservation Concern that has been declining in certain parts of its range for many years. Western burrowing owls have been studied on the NNSS since 1996 (Steen et al. 1997, Hall et al. 2003, Greger and Hall 2009, Hall et al. 2009, Conway et al. 2010, Hall and Greger 2014) and much has been learned about their natural history and ecology on their summer range. Little is known about their migration ecology including where they spend the winter, migration routes, and stopover sites. This type of information is important to understand threats to this species during migration and on their winter range.

New technology has recently become available to use satellites and GPS to track western burrowing owls over vast areas to identify specific migration routes, important stopover sites and wintering areas. Lightweight (5 g), solar-powered, Platform Transmitter Terminals (PTT) (Microwave Telemetry, Incorporated) are transmitters that are light enough to attach to western burrowing owls without exceeding the general rule of adding no more than 5% of an animal's body weight when attaching transmitters or other devices. In collaboration with Dr. Courtney Conway (University of Idaho), seven PTT's were attached to owls in June 2019 with results summarized in Hall and Perry (2021) and (2022). Additional transmitters were purchased in 2021, however, multiple searches for owls at previously occupied burrows yielded no owls during 2021 and 2022, likely due to drought conditions. In 2023, one transmitter was attached to an adult male with results summarized in Hall and Perry (2024). Transmitters last for one to two years. No owls are being monitored currently.

Multiple searches during 2024 found at least two breeding pairs of owls, one in a roadcut in Area 18 (Airport Road #1) and one on a drill pad in Area 8 (8D Road Drill Pad). Unfortunately, due to scheduling conflicts we were unable to capture and transmitter the owls so none were tracked during 2024. A new type of transmitter is now available, and we hope to attach several of these to owls in the next few years.

6.5 Bat Monitoring

Bat monitoring in 2024 consisted of documenting roost sites or locations of bats found around buildings or in other areas and continued long-term acoustic sampling at sites within North American Bat Monitoring Program (NABat) priority grid cells.

6.5.1 Documenting Bat Locations

An adult female California myotis (*Myotis californicus*) and an unknown myotis were removed and released from buildings at the Baker site in Area 27 on separate occasions. Two adult female California myotis were removed and released from the outdoor alcoves on the east and west side of a new building (01-350) at the PULSE facility (formerly U1a). Bats were observed using these alcoves on multiple occasions with sometimes as many as 15 bats day roosting there. An adult female California myotis suffered a broken wing during building demolition in Mercury and had to be euthanized. Two dead adult female California myotis were found in buildings, one at 23-180 in Mercury and one at the TRU Pad at the Area 5 RWMC. Another dead juvenile female California myotis was found at a boxcar in Mercury. One to three individual, unknown myotis bats roosted in the alcove near the entrance to building 23-652 in Mercury on multiple occasions for a few days to a few weeks. Locations where bats were found were entered in the EGIS faunal database. Additionally, 18 images of bats were photographed at 7 of 17 sites monitored for mountain lions, all of which were water sources (Table 6-6).

6.5.2 NABat Acoustic Sampling

NABat is a multi-national, multi-agency coordinated bat monitoring program across North America made up of an extensive community of partners who use standardized protocols to gather data that allows for assessing population status and trends, informing responses to stressors, and sustaining viable populations. A 10 x 10-km grid was overlaid across North America and certain grid cells were strategically selected for sampling. Four priority grid cells are located on the NNSS (Figure 6-5). Grid Cell 10662 is in the Mojave Desert ecoregion, Grid Cell 3494 is in the Fortymile Canyon area, Grid Cell 18854 is in northeastern Yucca Flat in the Transition ecoregion, and Grid Cell 7590 is on Pahute Mesa in the Great Basin Desert ecoregion. The placement of these grid cells is fortuitous because it allows us to sample a diverse assemblage of habitats, thus maximizing our chance of detecting all bat species that occur on the NNSS. Within each grid cell are four quadrants, and the intent is to sample within at least two of the four quadrants, preferably during May and June before the young become volant. The standard NABat monitoring protocol was followed for grid cell selection and sampling (Rodriguez et al. 2019).

We chose to use stationary acoustic monitoring as our primary sampling technique using Anabat Swift (Titley Scientific, Columbia, Missouri) passive full spectrum bat detectors. These detectors record the ultrasonic echolocation calls of bats which can be analyzed for species identification. One sampling location within two separate quadrants of each grid cell was selected based on specific habitat characteristics (Figure 6-5). The two locations within each grid cell were sampled concurrently with one bat detector per location. Detectors were attached to adjustable poles and raised to a height of 3 m and oriented toward the area of interest where bats were likely to pass through (Figure 6-6). Detectors were left out for a minimum of four consecutive nights. Acoustic files were downloaded and submitted to the NABat Data Processing Lab for analysis.

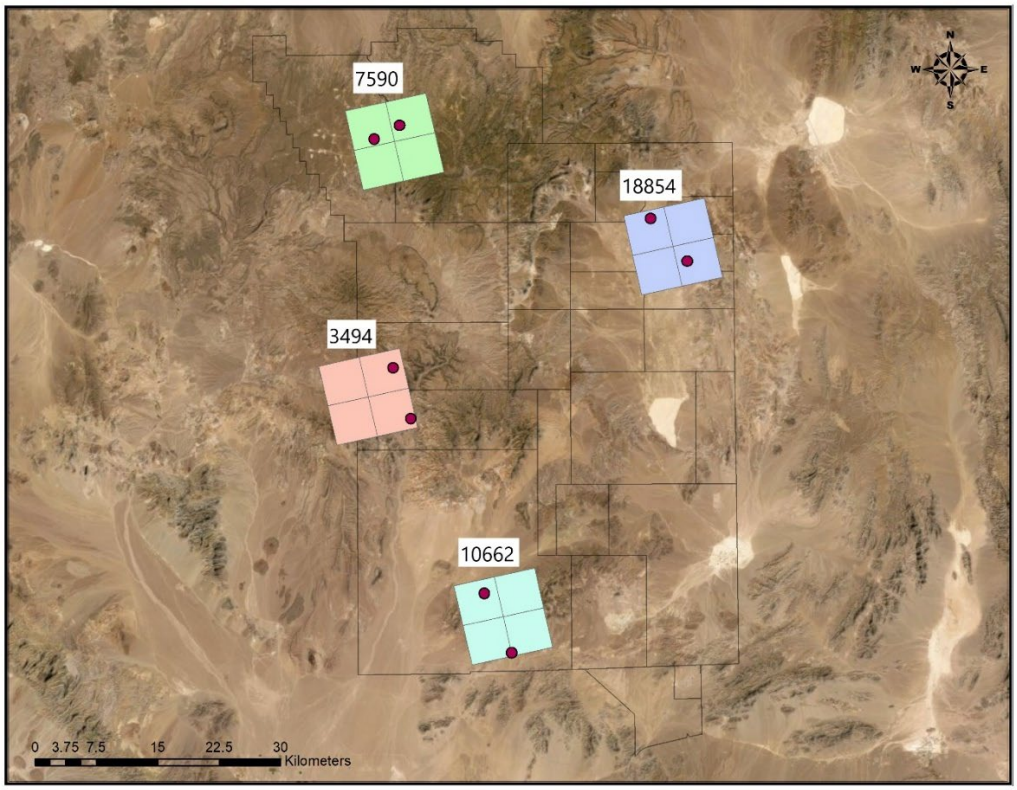

Figure 6-5. North American Bat Monitoring Program priority grid cells with four quadrants (colored numbered rectangles) and sampling locations (maroon dots).

The two sampling locations for Grid Cell 10662 were Rock Valley Tank (southwest quadrant) (Figure 6-6) and a desert wash on the north side of Little Skull Mountain (northwest quadrant) (Figure 6-7). Both these locations are in creosote bush-white bursage habitat. Rock Valley Tank is a small, natural water source in a limestone formation and the other location is a typical Mojave Desert wash draining off Skull Mountain and Little Skull Mountain. Detectors operated from May 6 to May 13.

The two sampling locations for Grid Cell 18854 were a wash near Papoose Lake Road (southeast quadrant) (Figure 6-8) and south of Sedan Crater (northwest quadrant) (Figure 6-9). The wash location is in a drainage that flows from the west side of the Halfpint Range in blackbrush habitat with scattered Joshua trees. The location south of Sedan Crater is in highly disturbed habitat with sparse perennial vegetation and abundant annual grasses and forbs. There are also some structures in the area that may provide roosting habitat for bats. Detectors operated from May 13 to May 20.

The two sampling locations for Grid Cell 3494 were at Twin Spring (southeast quadrant) (Figure 6-10) and North Chukar Canyon Tanks (northeast quadrant) (Figure 6-11). Twin Spring is a natural spring with perennial water. Nearby is an abandoned mine adit that is a known Townsend's big-eared bat (*Corynorhinus townsendii*) and fringed myotis (*Myotis thysanodes*) maternity colony. North Chukar Canyon Tanks are in a canyon that drains into Fortymile Canyon, surrounded by volcanic rock. It is an ephemeral water source but can hold water for a few months. There was water present while detectors operated from May 20 to May 30.

Figure 6-6. Bat detector at Rock Valley Tank, Grid Cell 10662.

(Photo by D.B. Hall, May 4, 2022)

Figure 6-7. Bat detector in a typical Mojave Desert wash north of Little Skull Mountain, Grid Cell 10662.

(Photo by D.B. Hall, May 4, 2022)

Figure 6-8. Bat detector at wash in blackbrush habitat near Papoose Lake Road, Grid Cell 18854.

(Photo by D.B. Hall, May 15, 2023)

Figure 6-9. Bat detector south of Sedan Crater, Grid Cell 18854.

(Photo by D.B. Hall, May 20, 2024)

Figure 6-10. Bat detector location at Twin Spring, Grid Cell 3494.

(Photo by D.B. Hall, May 30, 2024)

Figure 6-11. Bat detector location at North Chukar Canyon Tanks, Grid Cell 3494.

(Photo by D.B. Hall, May 20, 2024)

Two sampling locations for Grid Cell 7590 were Columbine Canyon (northeast quadrant) (Figure 6-12) and ER 20-6 sumps (northwest quadrant) (Figure 6-13). Columbine Canyon is in a small, narrow canyon in pinyon pine-Utah juniper-sagebrush habitat with adjacent cliff and rock features that provide potential bat roosting habitat. ER20-6 is a highly disturbed site surrounded by pinyon pine-Utah juniper-sagebrush habitat. There are several plastic-lined sumps that sometimes have water in them. The sumps were dry during sampling this year which occurred from June 6 to June 13.

Table 6-3 contains results from acoustic analysis from data collected in 2021-2024 by grid cell. A total of 14 bat species were detected, all of which were known to occur except the little brown bat (*Myotis lucifugus*) which has not been detected before on the NNSS. Surprisingly, silver-haired bat (*Lasionycteris noctivagans*) and western red bat (*Lasiurus frantzii*) were not detected but are known to occur from previous sampling efforts. The canyon bat (*Parastrellus hesperus*) and California myotis were the most prevalent being detected in all grid cells across all years. In addition, species richness is higher in Grid Cells 3494 and 7590 which may be due to higher elevation and presence of water at the sampling sites in these grid cells.

The minimum number of files detected of each species per site and date for 2024 is found in Table 6-4. Spotted bat (*Euderma maculatum*) was only detected at ER 20-6 Sumps and on each night of sampling. Yuma myotis (*Myotis yumanensis*) was only detected at Twin Spring and North Chukar Canyon Tank. Little brown bat was detected Twin Spring, Columbine Canyon, and ER 20-6. California myotis, western small-footed myotis (*Myotis ciliolabrum*), fringed myotis, and canyon bat were the most widespread and frequently detected bats.

Figure 6-12. Bat detector in Columbine Canyon, Grid Cell 7590.

(Photo by D.B. Hall, June 13, 2024)

Figure 6-13. Bat detector location at ER 20-6 Sumps, Grid Cell 7590.

(Photo by D.B. Hall, June 6, 2024)

Table 6-3. Presence (X) or undetected (blank cell) of bats by species and Grid Cell, 2021-2024.

Species	Grid Cell 3494			Grid Cell 7590			Grid Cell 10662				Grid Cell 18854			
	2022	2023	2024	2022	2023	2024	2021	2022	2023	2024	2021	2022	2023	2024
Pallid bat (*Antrozous pallidus*)	x	x	x	x		x				x		x	x	x
Townsend's big-eared bat (*Corynorhinus townsendii*)	x	x	x	x		x								
Big brown bat (*Eptesicus fuscus*)	x	x	x	x	x	x							x	
Spotted bat (*Euderma maculatum*)					x	x								
Hoary bat (*Lasiurus cinereus*)			x		x	x			x	x				x
California myotis (*Myotis californicus*)	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Western small-footed myotis (*Myotis ciliolabrum*)	x	x	x	x	x	x	x				x		x	x
Long-eared myotis (*Myotis evotis*)	x	x	x	x	x	x								
Little brown bat (*Myotis lucifugus*)		x	x			x								
Fringed myotis (*Myotis thysanodes*)	x	x	x	x	x	x						x		x
Long-legged myotis (*Myotis volans*)		x	x		x	x								
Yuma myotis (*Myotis yumanensis*)		x	x											
Canyon bat (*Parastrellus hesperus*)	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Brazilian free-tailed bat (*Tadarida brasiliensis*)			x			x				x				

6.6 Feral Horse Surveys

Formal feral horse surveys have not been conducted on the NNSS since 2014. Opportunistic surveys were conducted from 2017-2023 to get a general population estimate but were not conclusive. In 2024, NNSS biologists renewed feral horse monitoring and updated the protocol. Horses were surveyed during the summer for three consecutive days at Camp 17 Pond and an additional three consecutive days at Gold Meadows Spring. Past surveys have shown that horses are restricted to these two water sources during the hot, dry summer if no rain has been received because they provide the only reliable source of drinking water during this time. Surveys entailed conducting visual observations at the water sources and documenting all horses. Photos were taken of each individual horse to document identifying characteristics (e.g., unique facial blaze, overall color, color of stockings) and data were recorded onto a data sheet to identify each individual horse and track them over time. Horse photos taken by motion-activated cameras were also used to help identify and enumerate the number of horses.

A total of 36 unique horses were identified, including three foals (Figure 6-14), and a total of at least five bands were observed. A pair of lone gray horses of unknown sex were observed once around Band A, and another time when all the bands were found on June 20, 2024, drinking from Camp 17 Pond. Biologists concluded that this is either a separate band or a couple of lone stallions (i.e., a bachelor group) that roam around. During surveys, only one band of three horses was seen around Gold Meadows Spring (Figure 6-15). The other bands observed remained around Camp 17 Pond and its surrounding habitat. Occasionally these bands were found altogether at the same water source, but during the official survey period, bands were observed to be separate. Horse bands are dynamic and can change within a season. The number of adult horses found in 2024 is consistent with prior survey years (Figure 6-14). A contrast to prior years is fewer foals, and zero yearlings in 2024. Biologists will continue to conduct horse monitoring and document survival of foals seen in 2024. A total of 345 and 321 photos of horses were taken by motion-activated cameras at Camp 17 Pond and Gold Meadows Spring, respectively. An opportunistic sighting of 34 horses was documented at Camp 17 Pond on May 31, 2024. It included 31 adults, 2 foals, and 1 juvenile.

Table 6-4. Minimum number of files detected by grid cell, site, date, and species for 2024 (ANPA = *Antrozous pallidus*, COTO = *Corynorhinus townsendii*, EPFU = *Eptesicus fuscus*, EUMA = *Euderma maculatum*, LACI = *Lasiurus cinereus*, MYCA = *Myotis californicus*, MYCI = *Myotis ciliolabrum*, MYEV = *Myotis evotis*, MYLU = *Myotis lucifugus*, MYTH = *Myotis thysanodes*, MYVO = *Myotis volans*, MYYU = *Myotis yumanensis*, PAHE = *Parastrellus hesperus*, and TABR = *Tadarida brasiliensis*).

GRTS Cell	Location Name	Monitoring Night	ANPA	COTO	EPFU	EUMA	LACI	MYCA	MYCI	MYEV	MYLU	MYTH	MYVO	MYYU	PAHE	TABR
3494	NE_North_Chukar_Canyon_Tank	5/20/2024						2	1			2	1		1	
		5/21/2024						1	1			3				
		5/22/2024	1					1	1	1		2			1	
		5/23/2024						1	1			1			1	
		5/24/2024						1	1			1			1	
		5/25/2024						1	2			1			1	
		5/26/2024		1			1	1	1	1		2			1	
		5/27/2025	1					1	1			1		1	1	
		5/28/2024	1					1	1			1		1	1	
		5/29/2024	1					1	1			1		1	1	
	SE_Twin_Spring	5/20/2024	1	1				1				3			1	
		5/21/2024	4	1				1	1		1	2		1	1	
		5/22/2024	1	2				1	1			3		2	1	
		5/23/2024	2	1				1			1	5	1		1	
		5/24/2024		1				1				1		1	1	1
		5/25/2024		2				1	1			1		1	1	
		5/26/2024	1	1	1			1	1			4		1	1	
		5/27/2025	1	1	1			1				5			1	
		5/28/2024	1	1				1				3		1	1	
		5/29/2024	1	1				1	1			2		1	1	
7590	NE_Columbine_Canyon	6/6/2024	1						1	1	1				1	
		6/7/2024			1				1	1		1			1	
		6/8/2024							1			1				
		6/9/2024							1	1		1			1	
		6/10/2024							1	1						
		6/11/2024			1				1	1					1	
		6/12/2024	2		1			1	1	1	1	1			2	
	NW_ER20_6	6/6/2024	2	2	1	3		1	1	1	1	1			1	1
		6/7/2024	1	2	1	3	1		1	2	1	1	1		1	
		6/8/2024	1	1	1	2		1	1	1		2			1	
		6/9/2024	1	1	1	1		1	1	1	1	1			2	
		6/10/2024	2	1	1	1		1	1	2		1			1	
		6/11/2024	2	1	2	5		1	1	1	1	2			1	
		6/12/2024	1	1	1	3		1	1	1	1	1			3	1
10662	NW_North_Little_Skull_Wash	5/30/2024														
		5/31/2024														
		6/1/2024														
		6/2/2024														
		6/3/2024														
		6/4/2024														
	SW_Rock_Valley_Tank	5/6/2024						1							1	
		5/7/2024						1							1	
		5/8/2024	1												1	
		5/9/2024					1	1							1	
		5/10/2024													1	
		5/11/2024						1							1	1
		5/12/2024													1	
18854	NW_South_Sedan_Crater	5/13/2024	1				1		1						1	
		5/14/2024						1	1						1	
		5/15/2024							1			1			1	
		5/16/2024							1			3				
		5/17/2024						1	1			1			1	
		5/18/2024							1			1			1	
		5/19/2024						1	1			1			1	
	SE_Papoose_Road_Wash	5/13/2024						1	1							
		5/14/2024														
		5/15/2024							1						1	
		5/16/2024						1	1						1	
		5/17/2024						1							1	
		5/18/2024							1							
		5/19/2024							1							

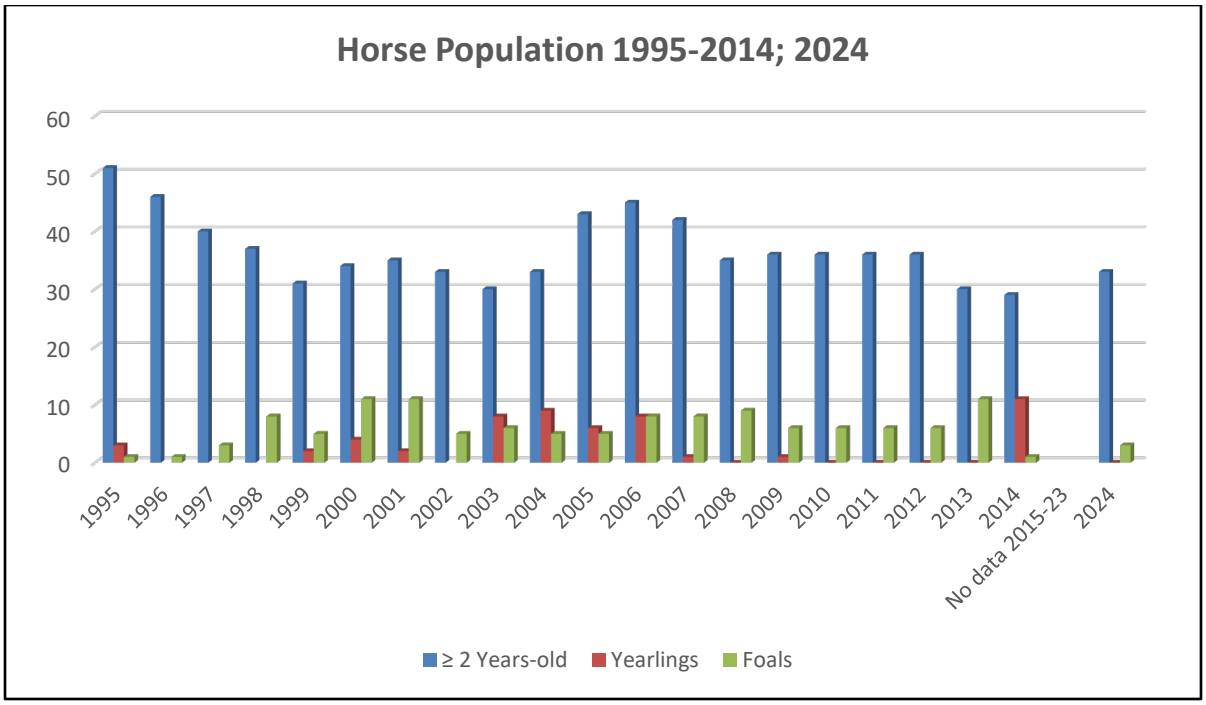

Figure 6-14. Total number of feral horses observed on the NNSS by year and age.

Figure 6-15. Three horses drinking at Gold Meadows Spring.

(Photo by F.K. Diaz, July 17, 2024)

6.7 Mule Deer

Initial studies of mule deer at the NNSS were conducted by Giles and Cooper (1985) from 1977 to 1982 when they performed mark and recapture studies on about 100 marked deer. They estimated the population to be about 1,500–2,000 deer. Spotlighting surveys for deer on the NNSS were conducted during 1989–1994, 1999–2000, and 2006–2024. In past years, monitoring has emphasized estimating relative abundance and density but since 2016 survey efforts have focused solely on relative abundance.

6.7.1 Trends in Mule Deer Abundance

Mule deer abundance on the NNSS was measured by driving two standardized (59 km total length) road courses to count and identify mule deer. Surveys were conducted at night starting around 0.5 hours after sunset, lasting approximately three hours. Deer were detected primarily by looking for eye shine, because the tapetum of the eye reflects green when exposed to light. One route (29 km) was centered around Rainier Mesa, and the second (30 km) was centered around the eastern portion of Pahute Mesa (Figure 6-16). Selection of the two routes was based on information from Giles and Cooper (1985) who determined there are two main deer herd components in these regions on the NNSS. Locations of mule deer were recorded with a handheld GPS unit from the road centerline. Perpendicular distance from the road to each deer group was measured with a laser range finder.

During six surveys conducted September 23-25 and October 7-9, 2024, a total of 70 deer were observed on both routes combined, which equates to an average of 11.7 deer per night. This is 2.6 times higher than the previous two years when 4.5 and 4.3 deer per night were observed, respectively. There has been a decreasing trend ($y = -2.0662x + 47.361$, $r^2 = 0.63$) for the last 19 years with counts fluctuating widely (Figure 6-17). The trend for the entire study period (1989–2024, excluding 1995–1998 and 2001–2005) is trending downward slightly ($y = -0.4078x + 34.934$, $r^2 = 0.11$). Specific causes for the fluctuation in deer numbers are unknown and require further investigation. Mountain lion predation and drought are likely candidates for the decrease during 2021 and 2022 and may have extended into 2023. During a mule deer study, 8 of 11 (73%) radio-collared mule deer that died during 2021 and 2022 were apparently killed by mountain lions. No fawns were observed on the deer surveys during the drought years of 2021 and 2022.

Encouragingly, fawns were observed twice during deer surveys in 2023 and five times in 2024. Precipitation during 2023 and 2024 was above normal which may explain the increase in fawn observations and higher deer survival.

Unlike 2023, the number of deer per 10 km in 2024 was higher on Pahute Mesa than Rainier Mesa (Figure 6-18). A total of 39 deer groups were detected and group size varied from one to five animals. Although more deer were observed on Pahute Mesa than Rainier Mesa, larger groups were found on Rainier Mesa (2.8 deer/group) than Pahute Mesa (1.4 deer/group).

6.7.2 Sex and Fawn/Doe Ratios

A mix of buck and doe observations were seen during the 2024 deer surveys including 33 buck, 16 doe, 5 fawn, and 16 of unknown sex and age observations. The deer sex ratio (number of bucks per 100 does) increased from 138 in 2023 to 206 in 2024 (Table 6-5). Our values overall show some similarity to historical sex ratios noted by Giles and Cooper (1985), who attributed the higher number of males to a lack of hunting on the NNSS. Generally, deer populations in hunted areas in the western U.S. have significantly fewer males compared to females in the population than measured on the NNSS.

The fawn/doe ratio (number of fawns per 100 does) was 31 in 2024 compared to 25 in 2023 and higher than in 2021 and 2022 when no fawns were detected (Table 6-5). The percentage of individuals

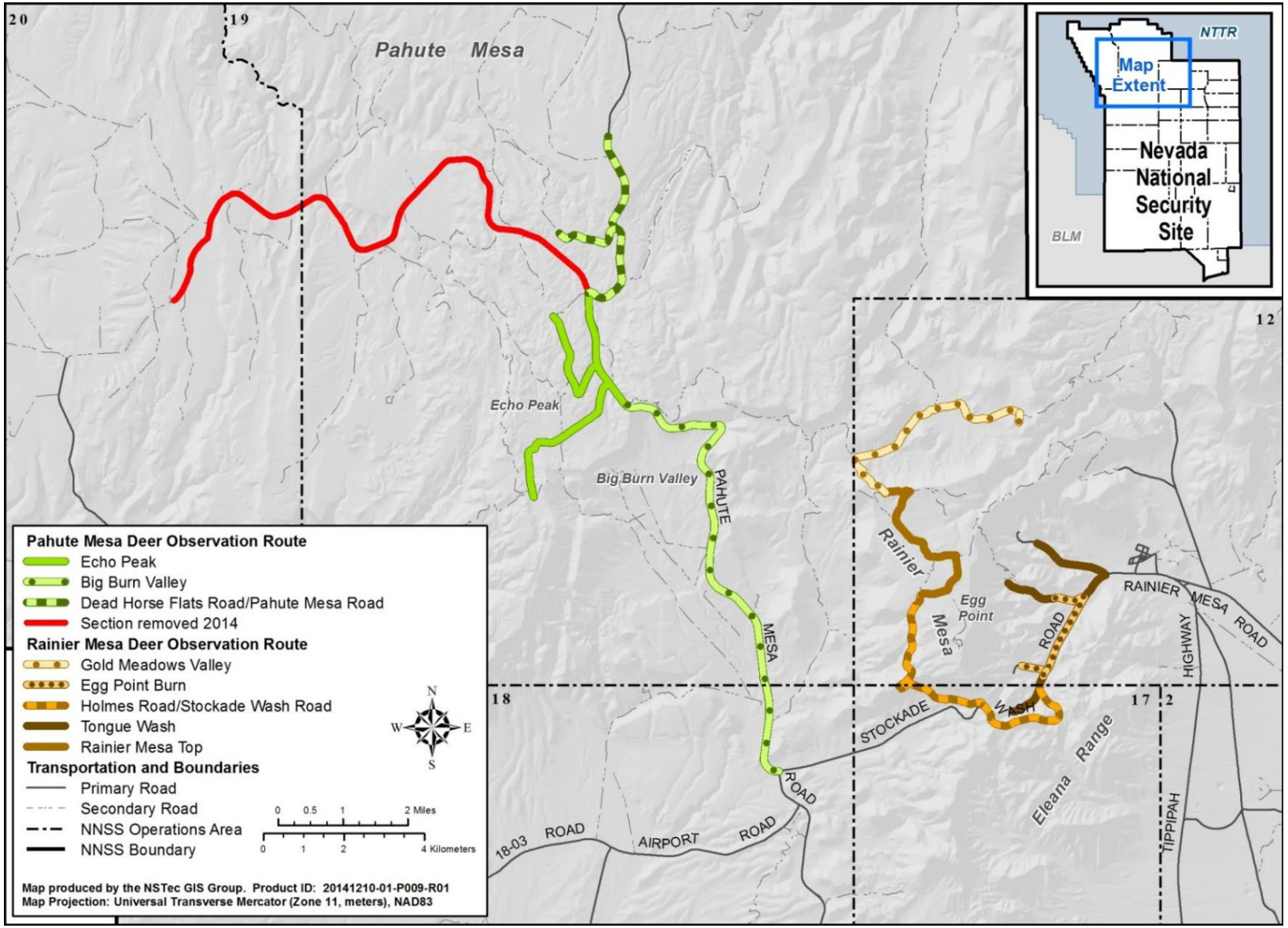

Figure 6-16. Road routes and sub-routes of two NNSS regions driven in 2024 to count deer and section removed due to road closure.

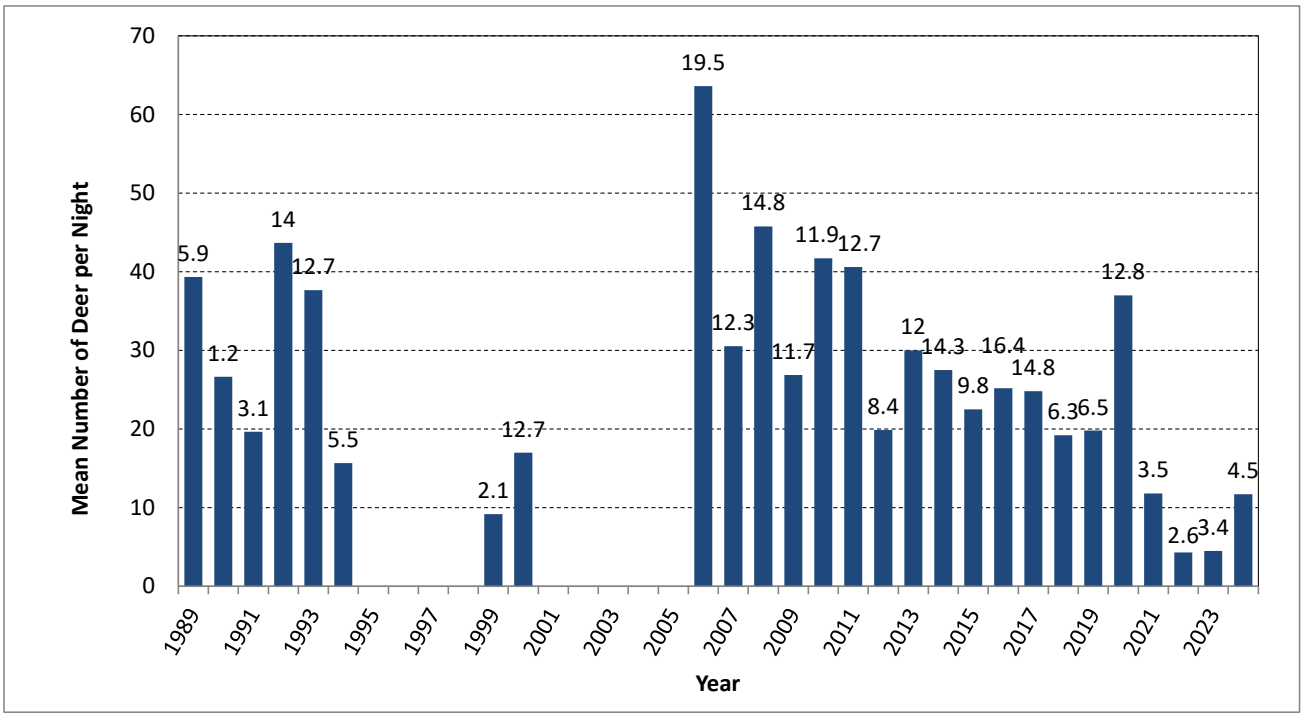

Figure 6-17. Trends in total deer count per night from 1989 to 2024 on the NNSS (surveys were not conducted during 1995–1998 or 2001–2005). Standard deviation values above bars.

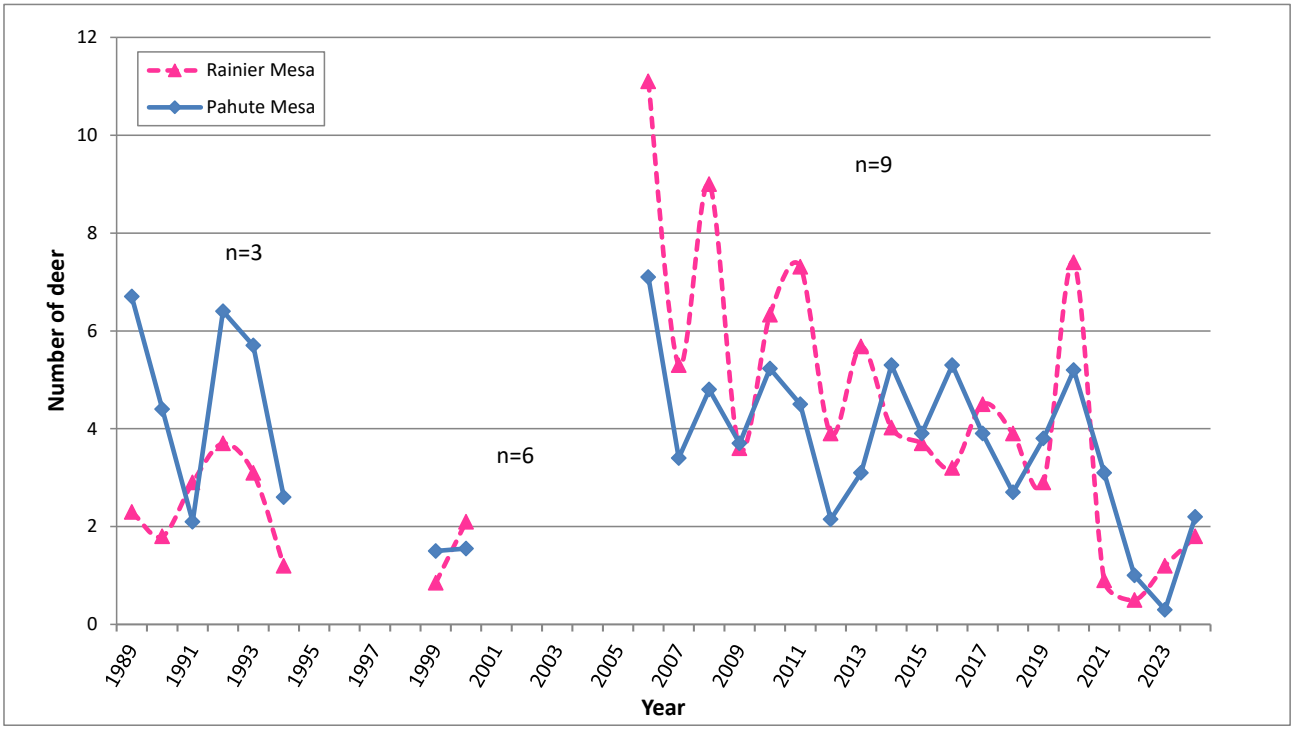

Figure 6-18. Mean number of mule deer per 10 km per night, counted on two routes (n = number of survey nights; exceptions n = 12 for 2012, n = 8 for 2013, n = 6 for 2015–2024).

Table 6-5. Mule deer classified by sex and age, with sex ratios, and fawn to doe ratios from 2006 to 2024 on the NNSS (12 survey nights for 2012, 8 for 2013, 6 for 2015–2024, 9 for all other years).

Year	Total Deer	Bucks	Does	Unclassified Sex	Bucks/100 does	Fawns	Fawns/100 does
2006	573	224	222	96	101	31	14
2007	275	148	68	59	218	0	0
2008	408	164	147	50	112	47	32
2009	242	98	102	35	96	7	7
2010	365	133	150	50	89	32	21
2011	477	189	184	67	103	37	19
2012	179	65	67	28	97	19	30
2013	243	106	68	38	156	31	45
2014	249	76	94	60	81	19	20
2015	135	33	58	19	57	25	43
2016	151	43	58	27	74	23	40
2017	149	52	42	44	124	11	26
2018	115	40	38	27	105	10	26
2019	119	41	47	21	87	10	21
2020	222	63	100	42	63	17	17
2021	71	46	9	16	511	0	0
2022	26	17	2	7	850	0	0
2023	27	11	8	6	138	2	25
2024	70	33	16	16	206	5	31

unclassified to sex and age in 2024 was 22.9% which is higher than the average percentage of unclassified sex and age since 2006 (19.2%). When deer are observed at long distances (150–200 m) from the vehicle, it can be difficult to determine if individuals are bucks, does, or fawns due to spotlight limitations. Deer that are greater than 200 m away from roads are difficult to detect using the spotlight technique.

6.7.3 Detection Rate

Detectability is an issue with spotlight surveys. Deer may be present within sighting distance of the road but hidden or not detectable due to topography or vegetation. We calculated a simple detection rate using radiocollared mule deer during 2020-2022 (22 deer in 2020, 10 in 2021, and 7 in 2022). All collared mule deer locations at 2000 hours Pacific Standard Time on the survey night were plotted in ArcMap (Version 10.2) along the survey route. Locations within 150 m of the road were identified as deer that were detectable. A total of 27 locations were identified and only two deer at these locations were detected during the surveys, resulting in a detection rate of 0.074. In other words, given our technique 7.4% of marked deer within 150 m of our survey routes were detected, so 92.6% went undetected. This is a very simple measure of detectability and assumes deer are at the same location during the duration of the survey. More work is required to get a more accurate detection rate.

6.8 Mule Deer and Pronghorn Antelope Distribution Study

Mule deer and pronghorn antelope are mobile game animals that inhabit the NNSS. Both are generally considered to be migratory with distinct winter and summer ranges. Mule deer typically prefer the forested, mountainous habitats in the northern and western portions of the NNSS while pronghorn

generally prefer the open valleys in the southern and eastern portions of the NNSS. Gold Meadows on the northern NNSS boundary is one of the few places where mule deer and pronghorn regularly occur together during the summer. Mule deer are much more abundant than pronghorn on the NNSS. Mule deer movements on the NNSS were studied more than 30 years ago (Giles and Cooper 1985) using radio-collars that required triangulating locations that lacked the accuracy of current GPS radio-collars. They identified summer and winter ranges and a couple of long-distance movements of mule deer into areas where hunting is allowed on public land. Mule deer in their study were not necessarily those known to be using radioactively contaminated locations.

Pronghorn are relatively new residents to the NNSS (first observed in 1991) and their use of the NNSS has never been studied but they are known to be widespread. Tsukamoto et al. (2003) report the distribution of pronghorn in Nevada as of 2002 with the nearest population to the NNSS being just north in Emigrant Valley. The NNSS represents a relatively recent expansion of pronghorn range in Nevada.

A research study involving the capture and radio-collaring of mule deer and pronghorn antelope on the NNSS was conducted from November 2019 to November 2022 to better understand the potential radiological dose to the off-site public via the hunter pathway. This was a true collaborative effort involving Dr. Kathy Longshore (Co-Principal Investigator, USGS), NDOW (Dr. Peregrine Wolff and Chris Morris [veterinarian support]; Joe Bennett, Pat Cummings, and Cody Schroeder [game biologists]), and NNSS biologists. NNSA/NFO and DOE Environmental Management Nevada Program (DOE EM/NV) graciously provided funding for the study. Study objectives included: 1) determine the distribution, abundance, and range of movements of mule deer and pronghorn, 2) estimate the potential for hunters to harvest mule deer and pronghorn which use the NNSS, 3) evaluate mule deer and pronghorn use of contaminated areas, 4) obtain information on the potential radiological dose to someone consuming deer and pronghorn from the NNSS, 5) determine the potential radiological dose to mule deer and pronghorn on the NNSS, 6) document survival and causes of mortality for both mule deer and pronghorn, 7) refine habitat use patterns for both mule deer and pronghorn using resource selection functions and correlate that with phenological changes in vegetation, and 8) assess the overall health, disease status, and genetics of NNSS mule deer and pronghorn.

Work on this study during 2024 focused on analyzing movement patterns in relation to phenological changes in the vegetation and habitat use. A final report is anticipated to be completed in 2025 or 2026.

6.9 Desert Bighorn Sheep

Prior to 2009, desert bighorn sheep (sheep) were rare visitors on the NNSS (Saethre 1994, Wills and Ostler 2001, Hall et al. 2017). Since 2009, numerous observations of sheep and sheep sign (i.e., scat, beds, and remains) have been detected with motion-activated cameras and during a recent mountain lion study, including the discovery of ewes and lambs in the Yucca Mountain/Fortymile Canyon area in 2011. These new data expanded the known distribution of sheep on and near the NNSS and prompted the radio-tracking study from 2015–2018. Results of this study were summarized in the 2018 EMAC Report (Hall and Perry 2019) and in a paper published in the 2019 Desert Bighorn Council Transactions (Hall et al. 2019). A comprehensive USGS Open File Report on the study is being finalized for publication by Dr. Kathy Longshore (USGS). Conclusions from the radio-tracking study recommend continued monitoring of the NNSS sheep population. Additional captures of three ewes on November 11, 2022, and subsequent tracking of these animals yielded even more data on location and movements and disease status of sheep on the NNSS. This study was done in collaboration with NDOW as part of a test and remove project to reduce the devastating impact of a disease that causes pneumonia in bighorn sheep. Oral, nasal, and blood samples were taken for disease testing, radio collars were attached, and the animals were then released. None of the animals tested positive for the disease. Animals were tracked during 2024, and they focused

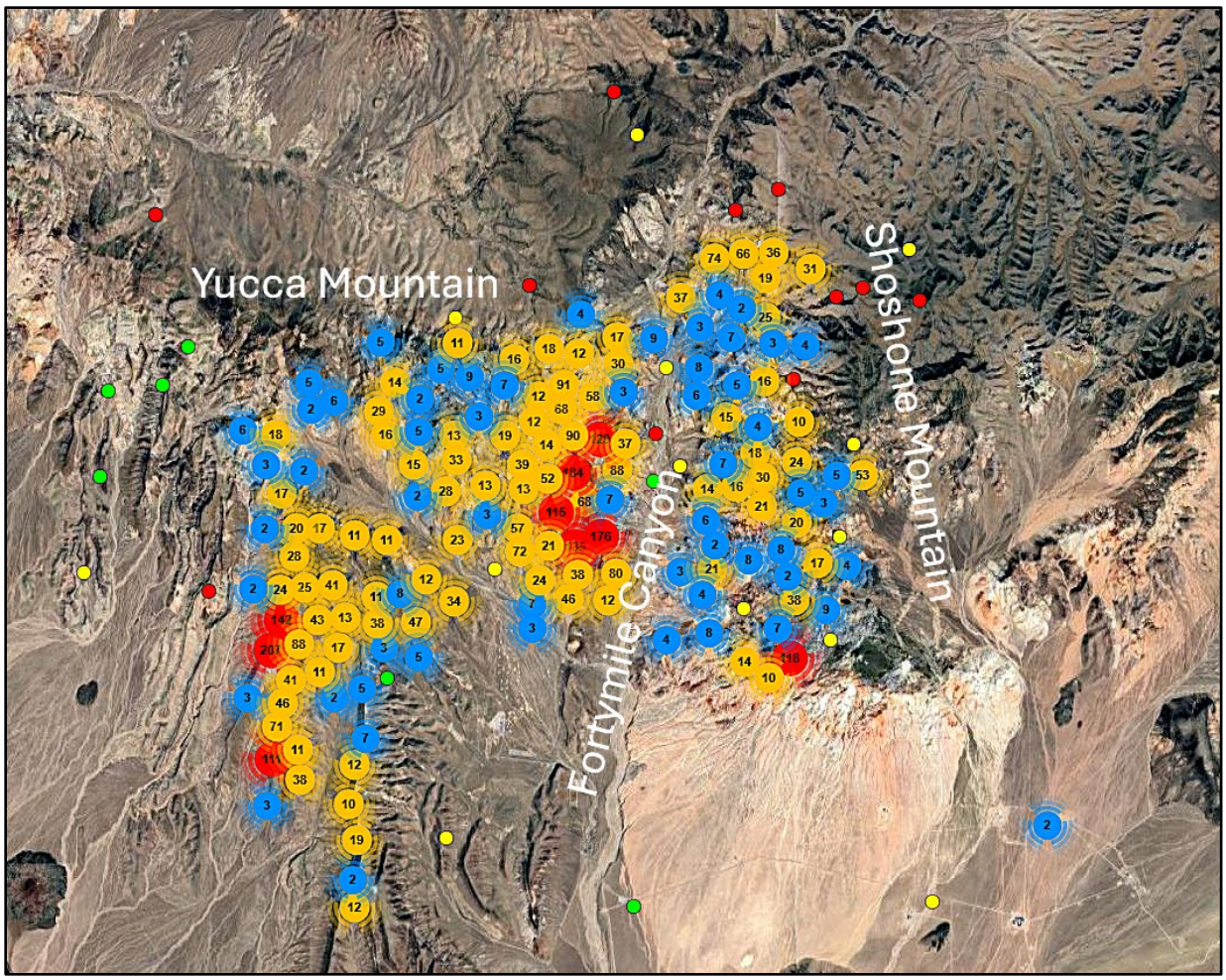

Figure 6-19. Locations of three ewes (red, yellow, green dots) during 2024. Circles with numbers represent number of locations of unspecified individuals close to each other (e.g., red circles indicate location clusters with the most locations and thus high activity areas).

their activity in Fortymile Canyon, Yucca Mountain, and the western slope of Shoshone Mountain (Figure 6-19).

Sheep use at several water sources was also recorded using camera traps. Desert bighorn sheep were detected at five water sources including 700 images of at least 15 individuals (6 marked ewes [686314, 686316, 686319, NT30, NT31, NT32], 4 unmarked ewes, 3 lambs, 1 mature ram, 1 young ram) at Cottonwood Spring (#4) (Figure 6-20); 326 images of at least 13 individuals (3 marked ewes [686314, 6866319, NT3?], 3 unmarked mature ewes, 1 yearling ewe, 2 lambs, 3 mature rams, 1 young ram) at Twin Spring (#16); 59 images of at least 13 individuals (3 marked ewes [686314, 686319, NT3?], 5 unmarked ewes, 3 lambs, 1 mature ram, 1 young ram) at Fortymile Canyon Tanks (#9); 2 images of unknown sex at South Pah Canyon Tanks (#11); and 1 image of a lamb at Delirium Canyon Tanks (#5). Combining these observations, at least 19 sheep (6 marked ewes, 5 unmarked ewes, 1 yearling ewe, 3 lambs, 3 mature rams, 1 young ram) were documented on the NNSS during 2024.

Figure 6-20. Desert bighorn sheep lamb nursing collared ewe 686316 (upper left) with ewe 686314, 686319 and unknown sheep at Cottonwood Spring (#4).

(Photo by motion-activated camera, June 29, 2024)

6.10 Mountain Lion Monitoring

6.10.1 Motion-Activated Cameras

Few data exist for mountain lion numbers and their distribution in Southern Nevada, including the NNSS. Since 2006, NNSS biologists have collaborated with Dr. Erin Boydston and Dr. Kathy Longshore, USGS research scientists, to use remote, motion-activated cameras to determine the distribution and abundance of mountain lions on the NNSS. Cameras used this way are referred to as camera traps. Remote, motion-activated cameras were used in 2024 at 17 sites (Figure 6-21 and Table 6-6). Sites were selected at locations with previous or new mountain lion sightings or sign, on roads or landform features that are potential movement corridors from one area to another, and in areas of good mule deer habitat (mule deer are a primary prey species for mountain lions). Some sites were also added based on other needs such as documenting the predator community in tortoise habitat or detecting animals at contaminated water sources or water troughs. The number of images reported is based on a 1-minute interval between images taken during a single episode. Some images reported herein were taken during late 2023 or early 2025 due to the accessibility and scheduling of camera trap visits.

A total of 393 mountain lion images (i.e., photographs or video clips) were taken during 124,741 camera hours across all sites (Figure 6-21 and Table 6-6). This equates to about 3.2 mountain lion images per

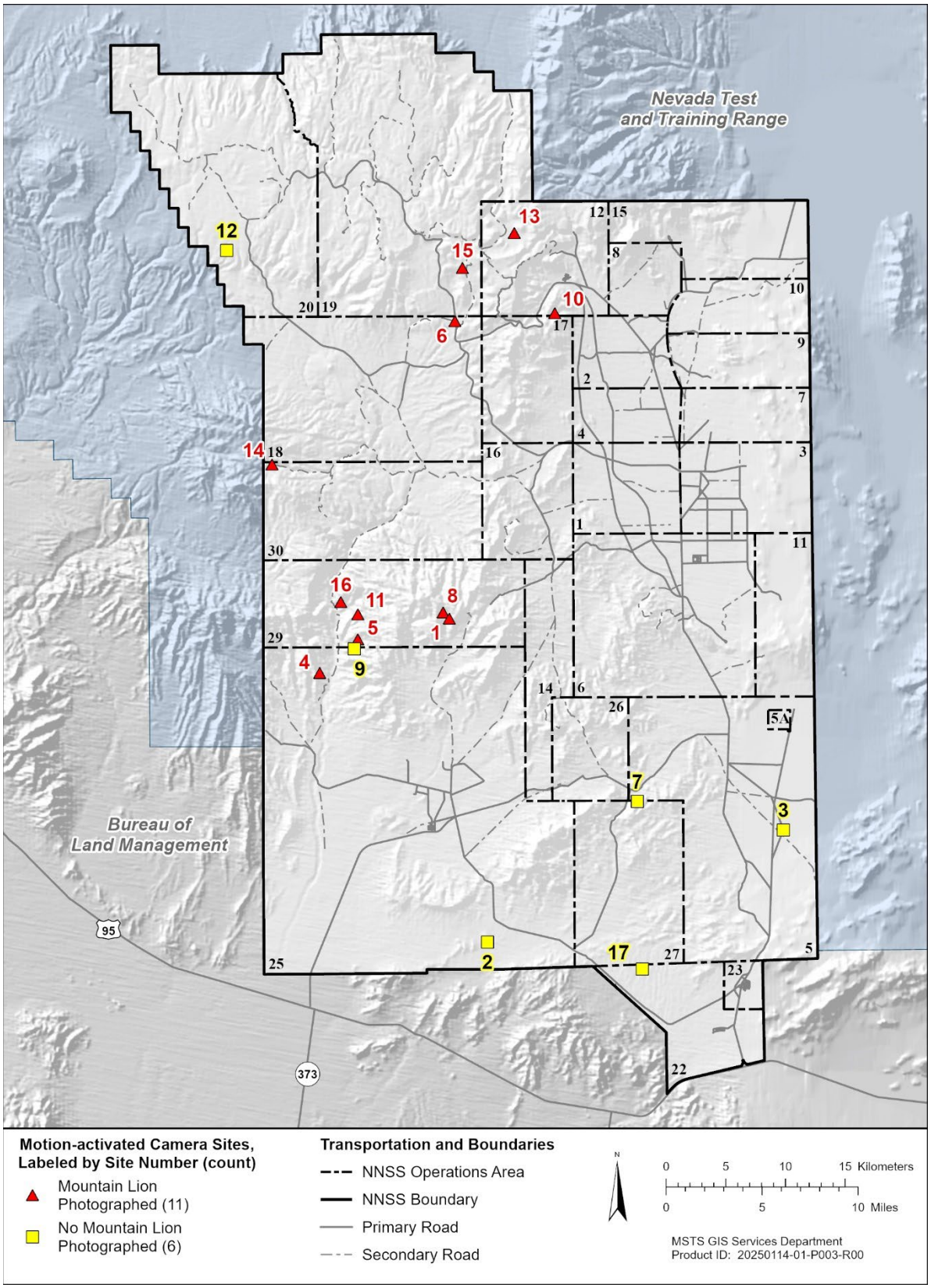

Figure 6-21. Locations of mountain lion photographic detections and camera traps on the NNSS during 2024.

Table 6-6. Results of mountain lion camera surveys during 2024 (a = non-continuous operation due to camera problems, dead batteries, full memory cards, etc.).

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Twin Spring (#16)	1/16/24-1/7/25[a]	6,581	155 (23.6)	Bobcat (8), coyote (38), badger (1), desert bighorn sheep (326), mule deer (1,351), feral burro (2,670), desert cottontail rabbit (1), bat (2), golden eagle (160), owl (1), turkey vulture (38), mourning dove (306), chukar (2,006), pinyon jay (256), greater roadrunner (9), common raven (449), Say's phoebe (2), house finch (98)
Camp 17 Pond (#6)	12/18/23-12/18/24	8,782	75 (8.5)	Bobcat (6), coyote (63), mule deer (275), feral horse (345), desert cottontail rabbit (9), black-tailed jackrabbit (13), bat (1), peregrine falcon (18), golden eagle (8), common blackhawk (14), Cooper's hawk (67), red-tailed hawk (721), great-horned owl (5), turkey vulture (728), chukar (335), mourning dove (196), common raven (347), white-faced ibis (12), great blue heron (3), lesser yellowlegs (4), spotted sandpiper (20), killdeer (1), western meadowlark (1), pinyon jay (6), greater roadrunner (3), scrub jay (7), red-shafted northern flicker (12), western kingbird (4), northern mockingbird (4), red-winged blackbird (2), hermit thrush (3), western bluebird (7), common poorwill (1), white-crowned sparrow (1), American robin (10), horned lark (3), brown-headed cowbird (41), house finch (29), Say's phoebe (1), dark-eyed junco (1), European starling (8), flame skimmer (1), dragonfly (1)
Captain Jack Spring (#10)	1/8-12/18/24[a]	5,976	27 (4.5)	Bobcat (3), gray fox (30), badger (1), mule deer (120), rock squirrel (2), bat (10), Cooper's hawk (12), chukar (189), mourning dove (230), pinyon jay (3), red-shafted northern flicker (1), common raven (16)

Table 6-6. Results of mountain lion camera surveys during 2024 (a = non continuous operation due to camera problems, dead batteries, full memory cards, etc.) (continued).

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Gold Meadows Spring (#13)	12/18/23-12/18/24	8,780	35 (4.0)	Bobcat (1), coyote (22), badger (1), pronghorn antelope (27), mule deer (30), feral horse (321), black-tailed jackrabbit (20), rock squirrel (1), bat (1), golden eagle (126), common blackhawk (1), red-tailed hawk (6), great-horned owl (2), Cooper's hawk (8), barn owl (1), turkey vulture (174), chukar (7), mourning dove (33), common loon (7), bufflehead (24), cinnamon teal (4), spotted sandpiper (47), common raven (24), greater roadrunner (1), loggerhead shrike (5), pinyon jay (2), scrub jay (1), Clark's nutcracker (4), western tanager (1), Cassin's kingbird (2), lark sparrow (10), house finch (1), Say's phoebe (3), brown-headed cowbird (32)
Cottonwood Spring (#4)	1/16/24-1/7/25	8,569	32 (3.7)	Bobcat (20), coyote (33), desert bighorn sheep (700), feral burro (4,438), bat (2), turkey vulture (5), chukar (730), mourning dove (288), common raven (39), loggerhead shrike (1), greater roadrunner (5), Bell's or sagebrush sparrow (35)
Topopah Spring (#8)	1/8/24-12/18/24[a]	4,748	17 (3.6)	Bobcat (12), gray fox (1), badger (11), spotted skunk (4), desert cottontail rabbit (35), rock squirrel (269), cliff chipmunk (18), white-tailed antelope ground squirrel (4), desert woodrat (132), pinyon mouse (1), Cooper's hawk (10), chukar (9,542), mourning dove (4), greater roadrunner (4), scrub jay (3), Bell's or sagebrush sparrow (1), white-crowned sparrow (1), black-throated sparrow (1), spotted towhee (11)
Rattlesnake Ridge Gorge (#15)	12/18/23-12/18/24	8,780	29 (3.3)	Rock squirrel (2)
Delirium Canyon Tanks (#5)	1/17/24-1/6/25[a]	3,355	5 (1.5)	Bobcat (5), gray fox (4), coyote (1), desert bighorn sheep (1), rock squirrel (14), chukar (5), mourning dove (133)

Table 6-6. Results of mountain lion camera surveys during 2024 (a = non continuous operation due to camera problems, dead batteries, full memory cards, etc.) (continued).

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Topopah Spring Trough (#1)	1/8-12/18/24	8,280	9 (1.1)	Bobcat (3), gray fox (5), coyote (3), mule deer (5), rock squirrel (6), bat (1), Cooper's hawk (2), owl (5), chukar (348), mourning dove (41), greater roadrunner (1), scrub jay (1), northern mockingbird (2)
South Pah Canyon Tanks (#11)	1/16/24-1/6/25[a]	6,553	6 (0.9)	Bobcat (3), gray fox (25), spotted skunk (5), desert bighorn sheep (2), rock squirrel (2), cliff chipmunk (6), white-tailed antelope ground squirrel (1), mourning dove (29), chukar (24), greater roadrunner (2), rock wren (22)
East Cat Canyon (#14)	1/8-12/18/24[a]	6,067	3 (0.5)	Bobcat (3), gray fox (14), coyote (1), mule deer (44), feral burro (9), black-tailed jackrabbit (3), greater roadrunner (1)
Fortymile Canyon Tanks (#9)	1/17/24-1/7/25	8,546	0 (0.0)	Bobcat (23), gray fox (13), desert bighorn sheep (59), rock squirrel (4), golden eagle (16), mourning dove (260), chukar (75), red-shafted northern flicker (1), Costa's hummingbird (1), yellow butterfly (1)
Cane Spring (#7)	1/5/24-1/6/25[a]	8,013	0 (0.0)	Bobcat (13), coyote (23), badger (1), mule deer (11), desert cottontail rabbit (43), greater roadrunner (2), scrub jay (2)
Well 5C Trough (#3)	1/5/24-1/6/25	8,805	0 (0.0)	Bobcat (1), kit fox (12), coyote (19), badger (10), pronghorn antelope (500), feral burro (4), desert cottontail rabbit (18), black-tailed jackrabbit (549), white-tailed antelope ground squirrel (255), mourning dove (707), common raven (245), greater roadrunner (16), western meadowlark (2), northern mockingbird (47), great-tailed grackle (5), dark-eyed junco (1), black-throated sparrow (32), common yellowthroat (2), house finch (3) brown-headed cowbird (3), Eurasian collared dove (7), European starling (15), house sparrow (3)

Table 6-6. Results of mountain lion camera surveys during 2024 (a = non continuous operation due to camera problems, dead batteries, full memory cards, etc.) (continued).

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Rock Valley Tank (#2)	1/5/24-1/6/25[a]	7,025	0 (0.0)	Bobcat (3), coyote (71), desert bighorn sheep (4), black-tailed jackrabbit (4), common raven (1), house finch (1), Costa's hummingbird (2)
Area 22, Juvenile GOAG Site 2 (#17)	1/5/24-1/6/25	8,804	0 (0.0)	Kit fox (1), coyote (5), badger (2), black-tailed jackrabbit (20), white-tailed antelope ground squirrel (3), great-horned owl (1), white-crowned sparrow (1), black-throated sparrow (1)
ER 20-5 Plastic-lined Sump (#12)	12/18/23-12/18/24[a]	7,077	0 (0.0)	Mule deer (1), bat (1), golden eagle (1), red-tailed hawk (2), turkey vulture (2), mourning dove (3), duck (25), common raven (81), Say's phoebe (3), brown-headed cowbird (4), house finch (1)

1,000 camera hours which is the highest value recorded since monitoring began in 2006. This suggests either a higher visitation rate at some of the water sources by the same individual(s) or possibly an increase in the mountain lion population. Mountain lions were detected at 11 of the 17 sites, including 9 water sources and 2 canyons (Figure 6-21). Table 6-7 contains the camera trap results by month and location. Figure 6-22 depicts a young male mountain lion at Twin Spring (#16). A total of 155 photos of mountain lions was recorded at Twin Spring with two-thirds of those occurring in September. This was likely the same young male that stayed around the spring, possibly hunting mule deer or bighorn sheep which were also using the spring. Figure 6-23 is a photo of a mountain lion at South Pah Canyon Tanks (#11). Figure 6-24 shows a mountain lion leaping up a cliff face at Delirium Canyon Tanks (#5). Figure 6-25 shows a mountain lion drinking from Cottonwood Spring (#4).

It is difficult to tell individual mountain lions apart from camera trap images and determine the exact number of mountain lions on the NNSS. At least four individuals (adult male, adult female, subadult male, subadult female) were documented in 2024 from the 17 camera traps. This compares to a minimum of four individuals in 2023, three individuals in 2022 and 2021, four individuals in 2020, three individuals in 2019 and 2018, four individuals in 2017, five individuals in 2016, three individuals in 2015, four individuals in both 2014 and 2013, and six individuals in 2012.

To investigate temporal activity of mountain lions, camera detection data from all 19 years (2006–2024) were combined. Mountain lions were detected every month with peak occurrences during November (n = 295) and September (n = 271) (Figure 6-26). The number of images taken during summer and fall (June–November) (n = 1,252) accounted for two-thirds of all images compared with the number of images taken during winter and spring (December–May) (n = 590) (Figure 6-26). Nearly three-fourths of mountain lion images were taken between 1700 to 0500 hours with peaks between 1700 to 1800, 2100 to 2200, and 0300 to 0400 hours Pacific Standard Time (Figure 6-27). From 2011 to 2024, nearly 1.9 times as many images were taken when it was dark (n = 1,075) compared with when it was light (n = 576).

A secondary objective of the camera surveys is to detect other species using these areas and thus to better define species distributions on the NNSS. A total of 33,017 images of at least 77 species other than mountain lions were taken during 124,741 camera hours across all sites which is about 265 images per 1,000 camera hours.

The most photographed species (40% of all images) was chukar (13,261 images at 10 of 17 sites) which is the most ever detected since camera monitoring began. Mourning dove images decreased significantly from 9,960 images at 10 of 22 sites in 2023 to 2,230 images at 12 of 17 sites in 2024. This is counterintuitive because precipitation was well above-normal in winters/spring 2023-2024 as it was in winter/spring 2022-2023. Mule deer were photographed 1,837 times at 8 of 17 sites compared to 573 images at 10 of 22 sites in 2023. Twin Spring (#16), Camp 17 Pond (#6), and Captain Jack Spring (#10) were important water sources for mule deer during 2024. Pronghorn antelope were detected in 527 images at two sites. Some of the rarer, more elusive, or species of interest documented from camera surveys were desert bighorn sheep (see Section 6.10), bobcat (found at 14 of 17 sites), gray fox (found at 7 of 17 sites), kit fox (found at 2 of 17 sites), golden eagle (found at 5 of 17 sites), badger (found at 7 of 17 sites), spotted skunk (found at 2 of 17 sites), peregrine falcon (found at 1 of 17 sites), pinyon jay (found at 4 of 17 sites), Cooper's hawk (found at 4 of 17 sites), and greater roadrunner (*Geococcyx californianus*; found at 10 of 17 sites) (Table 6-6). Greater roadrunner observations have increased the last few years, and they are widely distributed across the NNSS. Noteworthy observations of some of the more common species included 1,186 images of common ravens at 7 of 17 sites and 279 images of coyotes at 11 of 17 sites. Greatest use and highest species richness were documented at water sources (both natural and constructed) which emphasizes the importance of various water sources for several wildlife species, particularly during the drier months.

Table 6-7. Number of mountain lion images taken with camera traps by month and location, January 2024 through January 2025 (orange = number of mountain lion images; yellow = camera operational, no mountain lion images; green = camera not operational).

Camera Location (Site number)	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24	Jan-25
Cottonwood Spring (#4)	2	1	1	5	7	5	5	6					
Delirium Canyon Tanks (#5)												5	
South Pah Canyon Tanks (#11)	1		1		1					1		2	
Twin Spring (#16)			2						101	5	31	14	2
Topopah Spring (#8)									7	10			
Topopah Spring Trough (#1)				2	1	4		1		1			
East Cat Canyon (#14)											1	2	
Captain Jack Spring (#10)			10	1					9	2	5		
Camp 17 Pond (#6)		1			3	1	6	12	22	17	8	5	
Rattlesnake Ridge Gorge (#15)	1	2	3	10	6	2	1	2	1	1			
Gold Meadows Spring (#13)					6	8	6	8	3	4			

Number of mountain lion images

Camera operational, no mountain lions detected

Camera not operational

Figure 6-22. Young male mountain lion at Twin Spring (#16).

(Photo by motion-activated camera, September 17, 2024)

Figure 6-23. Mountain lion at South Pah Canyon Tanks (#11).

(Photo by motion-activated camera, October 11, 2024)

Figure 6-24. Mountain lion leaping up cliff face at Delirium Canyon Tanks (#5).

(Photo by motion-activated camera, December 18, 2024)

Figure 6-25. Mountain lion drinking at Cottonwood Spring (#4).

(Photo by motion-activated camera, April 23, 2024)

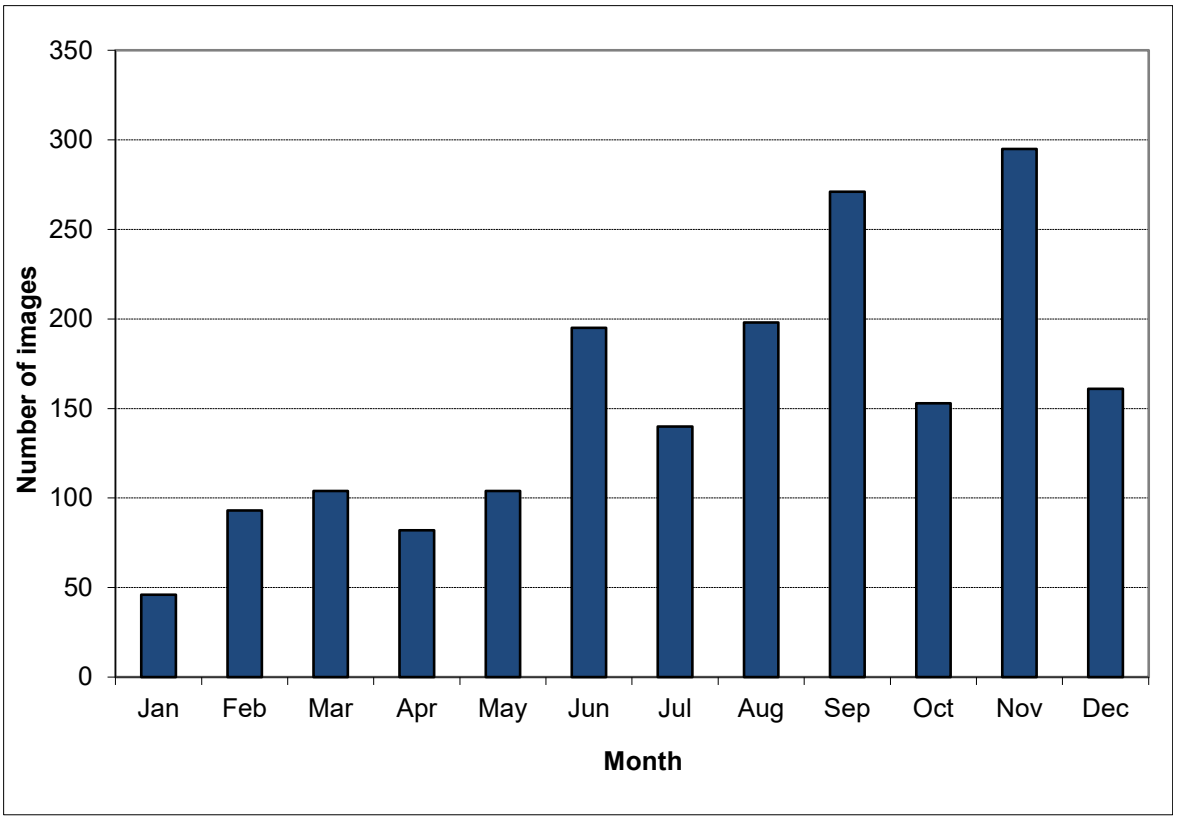

Figure 6-26. Number of mountain lion images by month for camera sites where mountain lions were detected from 2006 through 2024 (n = 1,842).

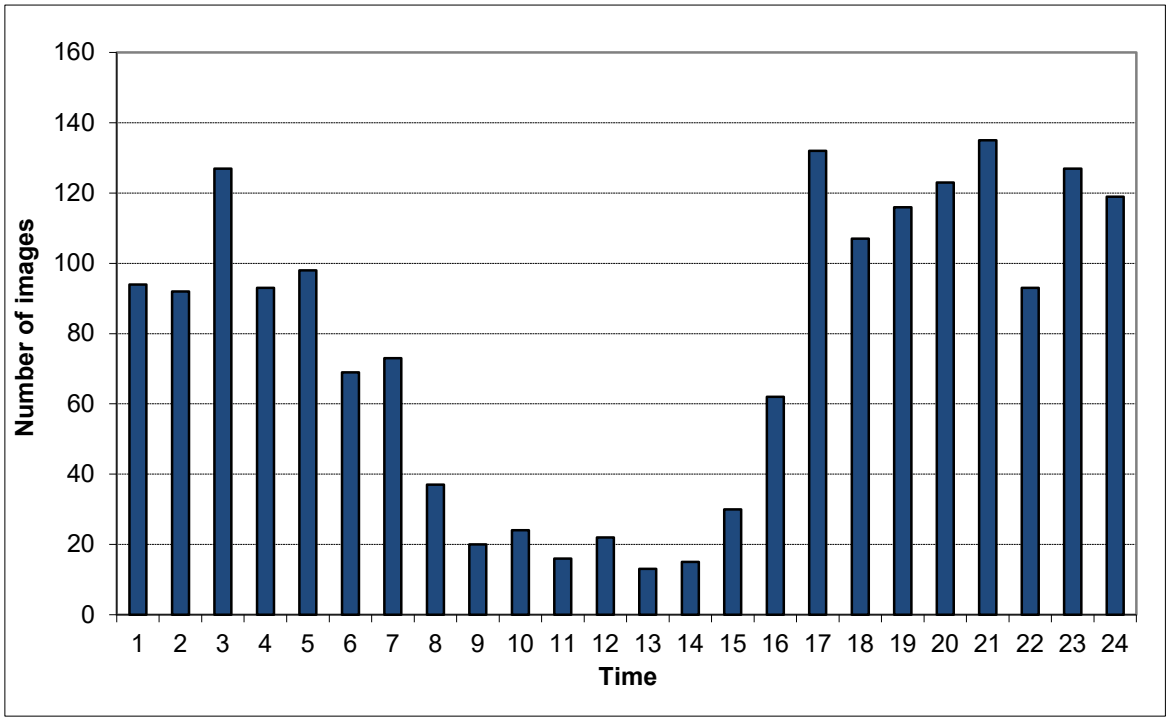

Figure 6-27. Number of mountain lion images by time of day (Pacific Standard Time) for camera sites where mountain lions were detected from 2006 through 2024 (n = 1,837).

6.11 Radiological Sampling

Sampling for radionuclides in game species (e.g., mule deer, pronghorn antelope, cottontail rabbit, waterfowl, mourning dove) was performed to 1) determine uptake of radionuclides left over from previous nuclear testing on the NNSS, 2) estimate the potential dose to a human consuming a contaminated animal, and 3) estimate the dose to the animal. Sampling is to ensure dose limits, set to protect human and animal health, are not exceeded. Many of these species are known to have large home ranges and may leave the NNSS and move into areas where hunting is allowed. This is a potential pathway for humans to receive a dose from radionuclides found on the NNSS and must be accounted for.

In 2024, eight tissue samples were collected and analyzed from three desert cottontail rabbits, two mule deer, two pronghorn antelope, and one desert bighorn sheep. Water was distilled from the tissue samples and submitted to a laboratory for tritium analysis. The remaining tissue samples were submitted for Strontium-90, Plutonium-238, Plutonium-239+240, Americium-241, and gamma spectroscopy analysis.

Results revealed elevated concentrations of tritium in one of the rabbits captured near Cane Spring and one mule deer from Area 2. Plutonium 239+240 was detected in another cottontail rabbit at Cane Spring and one desert bighorn sheep from Fortymile Canyon. Concentrations found were very low and do not present a hazard to the animal or a person eating them. For a more detailed analysis of specific radionuclides and dose assessments see MSTS (2024).

6.12 Nuisance and Potentially Dangerous Wildlife

During 2024, NNSS biologists documented 101 calls regarding nuisance, injured, dead, or potentially dangerous wildlife in or around buildings, power lines, and work areas on the NNSS. Problem, injured, or dead animals included birds (42 calls), bats (15 calls), other mammals (26 calls), reptiles (16 calls), and invertebrates (2 calls). Mitigation measures taken typically involved relocating the animals away from people, instructing workers to leave the animal in place, or disposing of dead animals.

Safety presentations were also given and sent out via employee communications to educate NNSS workers about some of the potential hazards NNSS wildlife pose and how to safely work to protect themselves and the animals that call the NNSS their home. A recurring major problem is that a few employees continue to feed wildlife, especially coyotes. This led to a worker being bit, which resulted in three coyotes having to be captured and euthanized.

6.13 Elk and Feral Burros

Historic studies on the NNSS do not mention the presence of Rocky Mountain elk (*Cervus elaphus*) (Jorgensen and Hayward 1965, Collins et al. 1982). Likewise, horses but not burros were mentioned by Jorgensen and Hayward (1965). Collins et al. (1982) conducted a biologic overview of the Yucca Mountain area and found that individual burros were occasionally observed near Cane and Topopah springs and documented numerous burro droppings in the central section of Yucca Mountain along the major ridges and in the eastern side canyons. They did not see any animals and concluded that burros used this area in winter and spring when ephemeral water and succulent plants were present. Site characterization studies at Yucca Mountain in the late 1980s and 1990s rarely documented burros, and elk were not documented at all.

Saethre (1994) reported that Rocky Mountain elk are resident outside the NNSS and rarely observed on the NNSS but did not document any specific sightings. Since 2009, there have been a few transient bull elk seen and photographed around Rainier Mesa and Pahute Mesa. Young bull elk are known to disperse

from their natal range, and it is likely that the source population for the bulls is to the north, possibly in the Groom or Kawich Range. During 2024, no elk were documented on the NNSS.

Feral burros appear to be increasing in number and expanding their range on the NNSS. A total of 7,121 images of feral burros were taken at 4 of 17 camera trap locations in Frenchman Flat, Fortymile Canyon, and for the third consecutive year in East Cat Canyon (#14). Most photos were taken at Cottonwood Spring (#4) and Twin Spring (#16) where they are causing heavy damage to both springs which may require fencing to maintain the integrity of the springs. Burros have also been observed in recent years in Mercury Valley.

6.14 Coordination with Biologists and Wildlife Agencies

NNSS biologists interfaced with other biologists and wildlife agencies in 2024 for the following activities:

- Co-authored the revised Nevada Bat Conservation Plan which was published in December 2024. https://heritage.nv.gov/assets/documents/December_2024_Nevada_Bat_Conservation_Plan.pdf
- Participated in the Nevada Bat Working Group meeting in December.
- Attended and gave a presentation on the NNSS burrowing owl monitoring program at the Partners-in-Flight spring meeting.
- Participated on the Springsnail Conservation Team.
- Gave multiple “hands-on” wildlife presentations using taxidermied animal specimens to school children at local elementary schools.
- Hosted a student-professional mixer for student members of the Nevada Chapter of The Wildlife Society

7.0 HABITAT RESTORATION IMPLEMENTATION AND MONITORING

NNSS biologists conduct revegetation activities at disturbances on and off the NNSS in support of NNSA/NFO and DOE EM/NV activities and continue to evaluate those efforts. The objectives of revegetation include: 1) establish a perennial vegetation community on waste closure covers to prevent water from infiltrating into buried waste through evapotranspiration, 2) establish a perennial vegetation community in disturbed areas (e.g., burned areas) to outcompete invasive annual grasses, reduce the risk of wildland fires, restore ecosystem function, and create wildlife habitat, 3) support the intent of U.S. Executive Order 13112, "Invasive Species," (1999) to prevent the introduction and spread of non-native species and restore native species to disturbed sites, and 4) revegetation may qualify as mitigation for the loss of desert tortoise habitat under the current Opinion.

Activities conducted in 2024 included: 1) qualitative vegetation assessment at the U-3ax/bl closure cover (Corrective Action Unit [CAU] 110) (Area 3 Radioactive Waste Management Site) and West Cover and North South Cover at the 92-Acre Site (CAU 111) (Area 5 RWMC), 2) revegetating and monitoring seeding success at South Cover (CAU 111), 3) monitoring revegetation success at Cell 21 (CAU 577) and North North Cover (CAU 111) and planting transplants at Cell 21 (CAU 577), 4) monitoring revegetation success at Cells 19/20 (CAU 577, Area 5 RWMC), 5) assessing revegetation success at East and West Cover Caps (CAU 577, Area 5 RWMC), 6) assessing revegetation success and planting transplants on Cell 18 (Area 5 RWMC), 7) monitoring results from a research study to evaluate the effectiveness of different herbicide treatments to control cheatgrass after the Cherrywood Fire, 8) aerially applying herbicide over large, previously burned areas to create firebreaks in cheatgrass dominated areas and monitoring results, and 9) monitoring seeding success in a revegetated area in the Area 16 Burn.

7.1 U-3ax/bl, Closure Cover (CAU 110)

The installation of an evapotranspiration cover on U-3ax/bl closure site (CAU 110) was completed in the fall of 2000. Once the evapotranspiration cover was in place, action was taken to establish a cover of native vegetation. Revegetation activities were completed in December 2000. The plant community on the closure cover has been monitored to document the vigor of the plant community that has established on the cover and to identify any remedial actions that may be necessary to ensure that it persists. Quantitative monitoring has included measurements of plant density and cover completed annually from the spring of 2001 through 2013, and every five years since. Qualitative assessments are completed during interim years. Precipitation in the vicinity of U3-ax/bl (CAU 110) was about 1.6 times the long-term average for the period December 2023 to April 2024, which created ideal conditions for plant growth.

A qualitative assessment of the vegetation was made on June 26, 2024. A meandering transect across the entire closure cover was walked. The vigor of perennial plant species was assessed based on current year's growth, whether plants were flowering, and if plants showed signs of stress (i.e., dead stems or leaves).

Shadscale saltbush (*Atriplex confertifolia*) continues to be the most abundant shrub species on the closure cover (Figure 7-1). Numerous dead shadscale saltbush plants were noted but many were still alive with no signs of stress. Nevada jointfir, the second most common perennial species on the closure cover, appeared to be thriving with no signs of stress. No perennial plant seedlings were seen. No perennial grasses have been found on the closure cover for several years and none were found again this year. Some annual plants from this year were documented but not in high densities. Saltlover (*Halogeton glomeratus*) and Russian thistle (*Salsola tragus*), both invasive weeds, were found in the unseeded portion on the periphery of the closure cover (Figure 7-2), highlighting the importance of seeding to establish a native

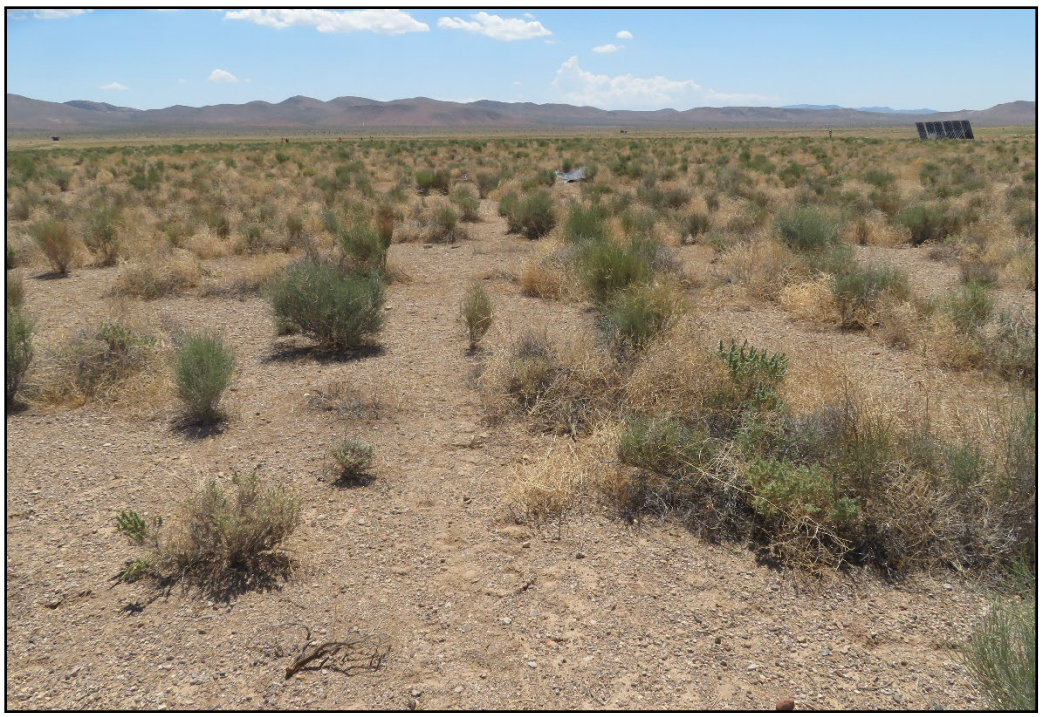

Figure 7-1. Overview of plant community that has established on U3-ax/bl (CAU 110) over the last 24 years.

(Photo by D.B. Hall, June 26, 2024)

Figure 7-2. Unseeded portion on the periphery of U3-ax/bl (CAU 110) occupied by invasive weeds and flatcrown buckwheat (left). Revegetated closure cover is on the right.

(Photo by D.B. Hall, June 26, 2024)

perennial vegetation community. Flatcrown buckwheat (*Eriogonum deflexum*), a native annual, was also observed in the unseeded portion.

7.2 92-Acre Site (CAU 111) Closure Covers

The 92-Acre Site (CAU 111) consists of four closure covers: South Cover, North South Cover, North North Cover, and West Cover. A qualitative vegetation assessment at North South Cover and West Cover was conducted on June 26, 2024. South Cover was revegetated during spring 2024 and seedling density counts were made. North North Cover was revegetated during spring 2023, sampled for seedling density during spring 2023, and sampled for density and cover in spring 2024. Precipitation received at the 92-Acre Site for the period December 2023 to April 2024 was about 1.6 times above the long-term average, resulting in excellent growing conditions.

North South Cover. This closure cover (3.7 ha) (Figure 7-3) was used for a revegetation trial over the last few years and has several plants remaining from the seeding and transplants, mostly fourwing saltbush (*Atriplex canescens*). There are also some large fourwing saltbush and numerous shadscale saltbush plants alive from revegetation efforts completed several years ago. It is estimated that about 25% of this cover has sufficient perennial plant density and cover. It is recommended that the remaining 75% be revegetated which is planned for spring 2025. Saltlover was the dominant plant found this year across the closure cover. There were some rodent burrows on the closure cover and one zebra-tailed lizard (*Callisaurus draconoides*) was observed.

Figure 7-3. North South Cover (CAU 111) with an abundance of weeds (primarily saltlover), scattered fourwing saltbush (large shrubs) from both recent revegetation trials and previous revegetation efforts, and abundant shadscale saltbush (small shrubs) from previous revegetation efforts.

(Photo taken June 26, 2024, by D.B. Hall)

West Cover. This site is currently under construction to fix some subsidence issues and prepare it for revegetation in 2026 (Figure 7-4). Only a small portion was undisturbed, and it was dominated by saltlover plants.

Figure 7-4. West Cover (CAU 111) under construction.

(Photo taken June 26, 2024, by D.B. Hall)

Overall, the integrity of the North South Cover and West Cover was very good. Due to the above-normal precipitation there was an abundance of saltlover that germinated on all the closure covers. No rabbits or rabbit sign were observed. Some rodent burrowing and ant activity were detected but do not appear to be impacting the integrity of the covers. No new antelope scat was found but a few reported antelope sightings in and around the compound indicate they are still in the area but do not appear to pose a threat to the integrity of the closure covers.

South Cover. This closure cover (7.2 ha) was revegetated during spring 2024 which included site preparation, seeding, hydromulching, and irrigation. Seedling density was measured to assess success and compared to a reference area near Area 5 RWMC. Site preparation entailed adding 23–30 cm of topsoil on top of the constructed closure cover to bury any existing weed seedbank and provide a good growing medium for seedlings. Soil was ripped perpendicular to the predominant slope to a depth of approximately 30–45 cm to alleviate soil compaction. A rabbit-proof fence was erected around the closure cover to prevent herbivory, especially on young seedlings.

The closure cover was seeded with a native seedmix comprised of seven shrub, two grass, and three forb species at a rate of 30 pounds of pure live seed per acre (PLS/ac) (Table 7-1). The seed was broadcast seeded onto the ground using a drill seeder calibrated to apply the specified rate of seed. A custom-built chain harrow was dragged behind the seeder to cover the seed to an appropriate depth (Figure 7-5). Following seeding, a straw mulch plus soil binder product (HydroStraw Guar Plus Formulation) was

Table 7-1. Seedmix used to revegetate South Cover including species, number of pure live seeds per square meter, and number of pounds of pure live seed per acre.

Lifeform	Common Name	Species (Variety)	Number of pure live seeds/m2	Pounds of pure live seed/acre
Shrub	White bursage	*Ambrosia dumosa*	80	3.8
Shrub	Fourwing saltbush	*Atriplex canescens*	44	3.2
Shrub	Shadscale saltbush	*Atriplex confertifolia*	77	4.8
Shrub	Cattle saltbush	*Atriplex polycarpa*	99	0.5
Shrub	Nevada jointfir	*Ephedra nevadensis*	39	8.0
Shrub	Winterfat	*Krascheninnikovia lanata*	17	0.6
Shrub	Creosote bush	*Larrea tridentata*	99	5.0
Grass	Indian ricegrass	*Achnatherum hymenoides*	80	2.0
Grass	Squirreltail	*Elymus elymoides (Toe Jam)*	47	1.0
Forb	Desert marigold	*Baileya multiradiata*	79	0.3
Forb	Palmer penstemon	*Penstemon palmeri (Cedar)*	45	0.3
Forb	Desert globemallow	*Sphaeralcea ambigua*	62	0.5
		TOTAL	768	30.0

Figure 7-5. Broadcast seeding with drill seeder and chain harrow.

(Photo taken February 12, 2024, by D.B. Hall)

applied over the seeded area (Figure 7-6) at a rate of 2,240 kilograms/hectare (kg/ha) for soil moisture retention, erosion control, and organic matter additive. An irrigation system using three wheel lines was installed and supplemental irrigation was applied for seedling germination and plant establishment (Table 7-2, Figure 7-7).

Figure 7-6. Applying Hydrostraw Guar Plus Formulation with a hydromulcher.

(Photo taken February 13, 2024, by D.B. Hall)

Table 7-2. Total amount of irrigation applied and natural precipitation in millimeters (mm) received during select months at South Cover in 2024. Numbers in parentheses in the irrigation column represent increments of irrigation (e.g., a total of 25.4 mm was applied in 6.4-mm increments in April). June amount was only applied to the north portion of closure cover.

Month(s)	Irrigation (mm)	Natural Precipitation (mm)
March 2024	36.6 (6.4)	18.3
April 2024	25.4 (6.4)	2.8
June 2024	47.8	0.0
Total	**109.8**	**21.1**

Figure 7-7. Irrigation system with all three wheel lines in operation.

(Photo taken March 20, 2024, by D.B. Hall)

Seedling density was measured on June 25 and 26, 2024, along 15, permanent, 100-m long transects (Figure 7-8). Results are found in Table 7-3. Overall, plant density on the South Cover is much higher than on the reference area (24.27 versus 1.13 plants/square meter [m^2]). Additionally, all 12 seeded species germinated which is highly encouraging. The presence of two invasive weeds, Russian thistle and saltlover, is somewhat concerning and will be monitored closely because it could impact seedling establishment.

North North Cover. This site (1.7 ha) was revegetated during spring 2023, and plant density was measured in June 2023 along five, permanent, 100-m long transects. Numerous creosote bush and white bursage seedlings germinated after summer rains in 2023 alongside good plant densities and cover from seeding; therefore, it was decided not to plant transplants on this closure cover as previously planned. Plant density and percent cover was measured in June 2024 along the same transects as in 2023 (Figures 7-9 and 7-10). Due to high numbers, Arabian schismus and saltlover density was counted in the upper right quadrant (0.25 m^2) and then multiplied by four to get number of plants/m^2. New seedlings encountered in 2024 were differentiated from mature plants to evaluate the seedbank effect. Only live plants or current year's annual plants were recorded for both density and cover. Density and cover results are found in Tables 7-4 and 7-5; respectively, along with density data from 2023 and the 2023 reference area density and cover data. Overall perennial plant density declined as expected from 2023 to 2024 (21.16 versus 11.54 plants/m^2) but is still an order of magnitude higher than in the reference area (1.10 plants/m^2). Indian ricegrass, Nevada jointfir, white bursage, desert marigold, and cattle saltbush had the highest densities. All 12 seeded species were found, which is promising. Of particular interest is the relative high density of white bursage and creosote bush that can be difficult to germinate and establish

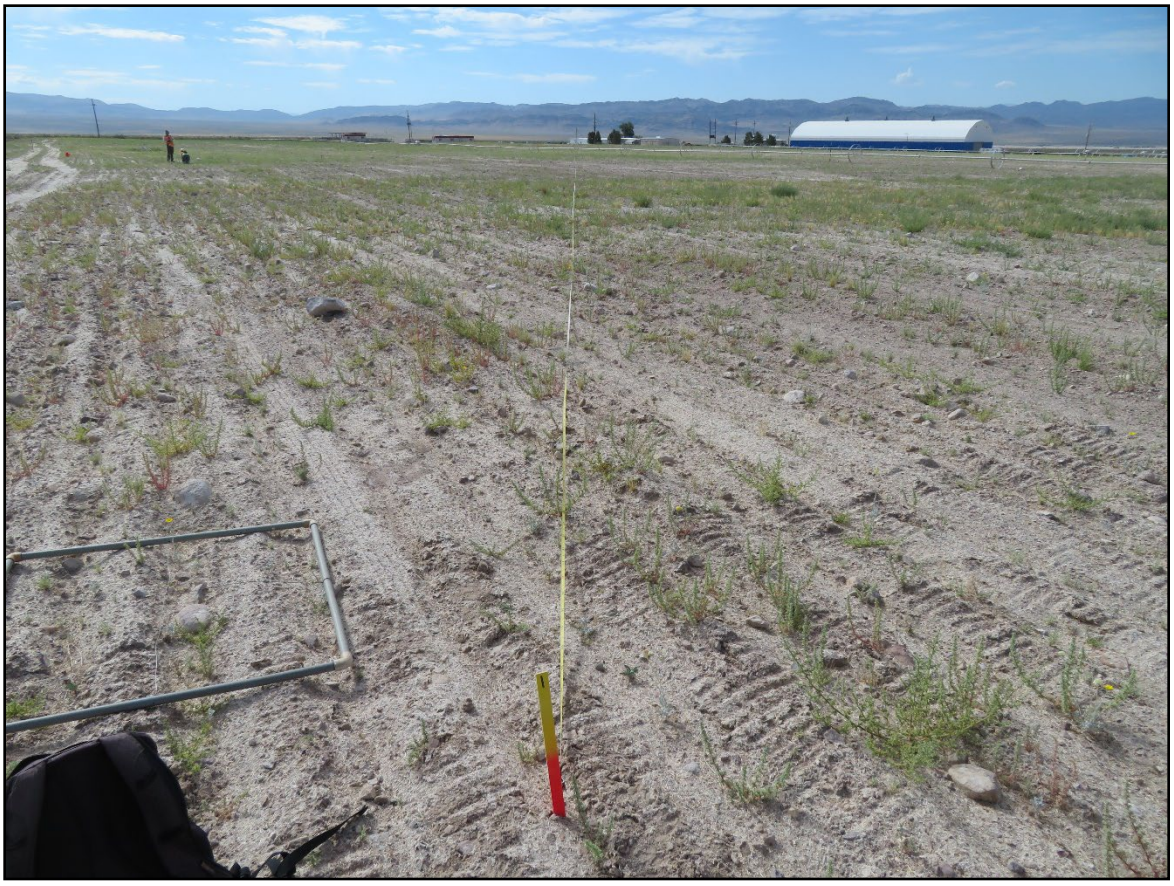

Figure 7-8. Plant density sampling transect, South Cover (CAU 111).

(Photo taken June 25, 2024, by D.B. Hall)

from seed. The high densities of saltlover and Russian thistle is somewhat worrisome and will be monitored for impacts to survival of seeded plants. Overall, seeded plant densities are very high and will hopefully establish and persist over the next several years.

Percent perennial plant cover on North North Cover is almost double that found in the reference area with Indian ricegrass dominating, followed by desert marigold, cattle saltbush, Nevada jointfir, white bursage, and fourwing saltbush. Saltlover and Russian thistle cover is moderately high and will need to be monitored closely as mentioned above.

Table 7-3. Plant density (plants/m^2) by species and lifeform on South Cover (CAU 111) compared to the reference area (S = seedlings).

Lifeform/Species	South Cover (2024)	Reference Area (2023)
Perennial Shrubs		
White bursage	0.15 S	0.09
Fourwing saltbush	1.72 S	0.00
Shadscale saltbush	0.34 S	0.17; 0.01 S; 0.18 Total
Cattle saltbush	12.71 S	0.00
Nevada jointfir	4.73 S	0.06
Winterfat	0.07 S	0.02
Creosote bush	0.46 S	0.03
Littleleaf ratany (not seeded)	0.00	0.31
Spiny hopsage (Not seeded)	0.00	0.01
Water jacket (not seeded)	0.00	0.02
TOTAL	**20.18 S**	**0.71; 0.01 S; 0.72 Total**
Perennial Grasses		
Indian ricegrass	0.27 S	0.07; 0.26 S; 0.33 Total
Squirreltail	1.87 S	0.00
TOTAL	**2.14 S**	**0.07; 0.26 S; 0.33 Total**
Perennial Forbs		
Desert marigold	1.59 S	0.00
Palmer's penstemon	0.31 S	0.00
Desert globemallow	0.05 S	0.00
Astrag alus species	0.00	0.08
TOTAL	**1.95 S**	**0.08**
TOTAL PERENNIALS	**24.27 S**	**0.86; 0.27 S; 1.13 Total**
Annual Grasses		
Arabian schismus	0.61	14.88
Cheatgrass	0.16	2.04
Red brome	0.05	1.17
Foxtail barley	0.00	0.00
Sixweeks fescue	0.00	2.21
TOTAL	**0.83**	**20.30**
Annual Forbs		
Saltlover	3.76	0.00
Russian thistle	4.70	0.00
Others	0.07	30.71
TOTAL	**8.53**	**30.71**
TOTAL ANNUALS	**9.33**	**51.01**

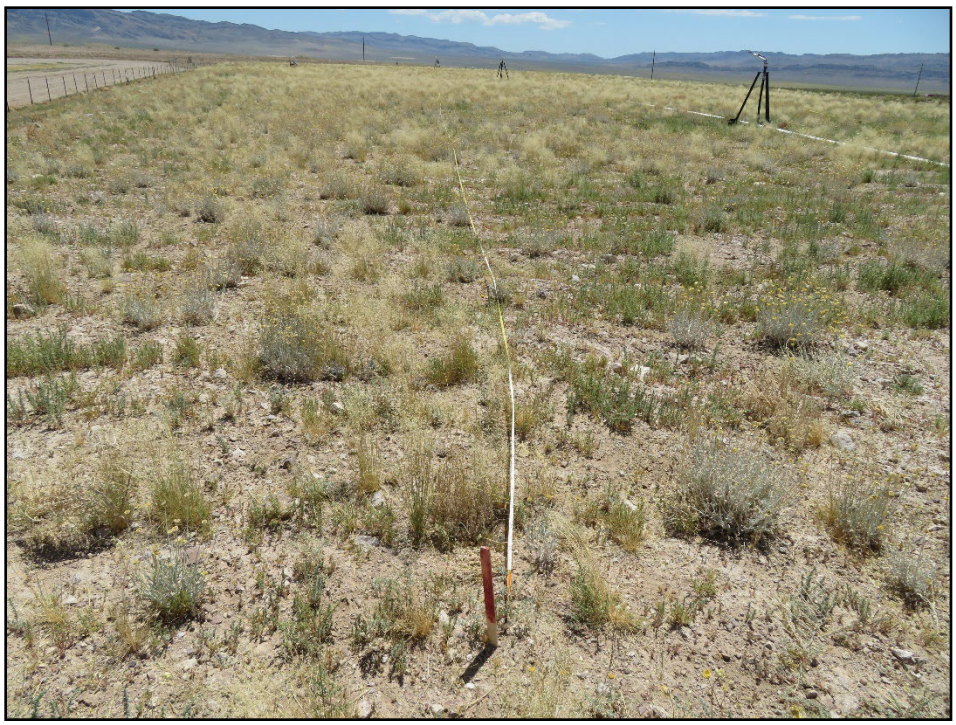

Figure 7-9. Plant density and cover sampling transect, west side North North Cover (CAU 111).

(Photo taken June 6, 2024, by D.B. Hall)

Figure 7-10. Plant density and cover sampling transect, east side North North Cover (CAU 111).

(Photo taken June 6, 2024, by D.B. Hall)

Table 7-4. Plant density (plants/m^2) by species and lifeform on North North Cover (CAU 111) compared to the reference area (S = seedlings, Total = mature plants and seedlings combined).

Lifeform/Species	North North Cover (2023)	North North Cover (2024)	Reference Area (2023)
Perennial Shrubs			
White bursage	0.43 S	0.85; 0.41 S; Total 1.26	0.09
Fourwing saltbush	0.23 S	0.19	0.00
Shadscale saltbush	0.00	0.01	0.17; 0.01 S; 0.18 Total
Cattle saltbush	1.45 S	0.96	0.00
Nevada jointfir	6.07 S	3.13; 0.01 S; 3.14 Total	0.06
Winterfat	0.03 S	0.04	0.02
Creosote bush	0.00	0.41 S; Total 0.41	0.03
Littleleaf ratany (not seeded)	0.00	0.00	0.31
Spiny hopsage (not seeded)	0.00	0.00	0.01
Water jacket (not seeded)	0.00	0.00	0.02
TOTAL	**8.21 S**	**5.18; 0.83 S; 6.01 Total**	**0.71; 0.01 S; 0.72 Total**
Perennial Grasses			
Indian ricegrass	11.13 S	4.22; 0.06 S; Total 4.280	0.07; 0.26 S; 0.33 Total
Squirreltail	0.55 S	0.06	0.00
TOTAL	**11.68 S**	**4.28; 0.06 S; 4.34 Total**	**0.07; 0.26 S; 0.33 Total**
Perennial Forbs			
Desert marigold	0.90 S	1.07; 0.02 S; Total 1.09	0.00
Palmer's penstemon	0.36 S	0.07	0.00
Desert globemallow	0.01 S	0.02; 0.01 S; Total 0.03	0.00
Astragalus spp.	0.00	0.00	0.08
TOTAL	**1.27 S**	**1.16; 0.03 S; 1.19 Total**	**0.08**
TOTAL PERENNIALS	**21.16 S**	**10.62; 0.92 S; 11.54 Total**	**0.86; 0.27 S; 1.13 Total**
Annual Grasses			
Arabian schismus	0.00	3.12	14.88
Cheatgrass	0.00	0.00	2.04
Red brome	0.00	0.00	1.17
Sixweeks fescue	0.00	0.00	2.21
TOTAL	**0.00**	**3.12**	**20.30**
Annual Forbs			
Saltlover	1.83	68.00	0.00
Russian thistle	0.21	20.05	0.00
Others	0.00	0.00	30.71
TOTAL	**2.04**	**88.05**	**30.71**
TOTAL ANNUALS	**2.04**	**91.17**	**51.01**

Table 7-5. Percent cover in 2024 by species and category on North North Cover (CAU 111) compared to the reference area.

Category/Species	North North Cover (2024)	Reference Area (2023)
Perennial Shrubs		
White bursage	1.2	0.1
Fourwing saltbush	1.0	0.0
Shadscale saltbush	0.0	2.4
Cattle saltbush	3.0	0.0
Nevada jointfir	1.8	1.1
Winterfat	0.0	0.1
Creosote bush	0.2	2.3
Littleleaf ratany (Not seeded)	0.0	3.7
Water jacket (Not seeded)	0.0	0.9
Beaked spiny polygala (Not seeded)	0.0	0.1
TOTAL	**7.2**	**10.7**
Perennial Grasses		
Indian ricegrass	10.2	0.2
TOTAL	**10.2**	**0.2**
Perennial Forbs		
Desert marigold	3.8	0.0
Palmer's penstemon	0.4	0.0
TOTAL	**4.2**	**0.0**
TOTAL PERENNIALS	**21.6**	**10.9**
Annual Grasses		
Arabian schismus	0.0	1.4
Cheatgrass	0.0	0.4
Red brome	0.0	0.2
TOTAL	**0.0**	**2.0**
Annual Forbs		
Saltlover	6.4	0.0
Russian thistle	5.0	0.0
Other annual forbs	0.0	2.5
TOTAL	**11.4**	**2.5**
TOTAL ANNUALS	**11.4**	**4.5**
TOTAL VEGETATIVE COVER	**33.0**	**15.4**
Cobble (8-25 cm)	0.6	0.0
Gravel (0.5-8 cm)	37.6	61.6
Bare ground	4.6	15.3
Straw mulch	10.6	0.0
Litter	13.6	7.7
TOTAL ABIOTIC	**67.0**	**84.6**

7.3 Reference Area

A reference area was established approximately 800 m east of the Area 5 RWMC (Figure 7-11). Plant data from this area will be used as a standard to compare revegetation success on all cover caps in Area 5 RWMC. Ten, 100-m long, permanent transects were established in this area and sampled June 8 and 10, 2021 (drought conditions) and May 13, 2023 (above-normal precipitation). Plant density was sampled using 1-m x 1-m sampling quadrats placed at 5-m intervals along the transect for a total of 20 square meters sampled per transect. All plant species found inside the quadrat were counted and summed by species. Due to high numbers, Arabian schismus density was counted in the upper right quadrant (0.25 m^2) and then multiplied by four to get number of plants/m^2. New seedlings encountered in 2023 were differentiated from mature plants to evaluate the seedbank effect. Average number of plants per square meter by species were then calculated (Table 7-6). In addition, plant cover was measured using an optical cover scope that projects a point straight downward on the ground and whatever that point intercepts (e.g., plant species, litter, bare ground, gravel [0.5–8.0 cm], cobble [8.0–25.0 cm], or rock [>25.0 cm]) gets recorded. Data from four points (45, 135, 225, and 315 degrees), every four meters, for a total of 100 points were recorded for each transect. These data were summarized, and average percent cover was calculated (Table 7-7). Only live plants or current year's annual plants were recorded for both density and cover.

Overall plant density and cover, especially the grasses and annual forbs, was expectedly higher during 2023, due to the above-average winter/spring precipitation compared to 2021 under drought conditions. Annual forb species richness (i.e., number of species) was substantially higher in 2023 than in 2021 (30 versus 1).

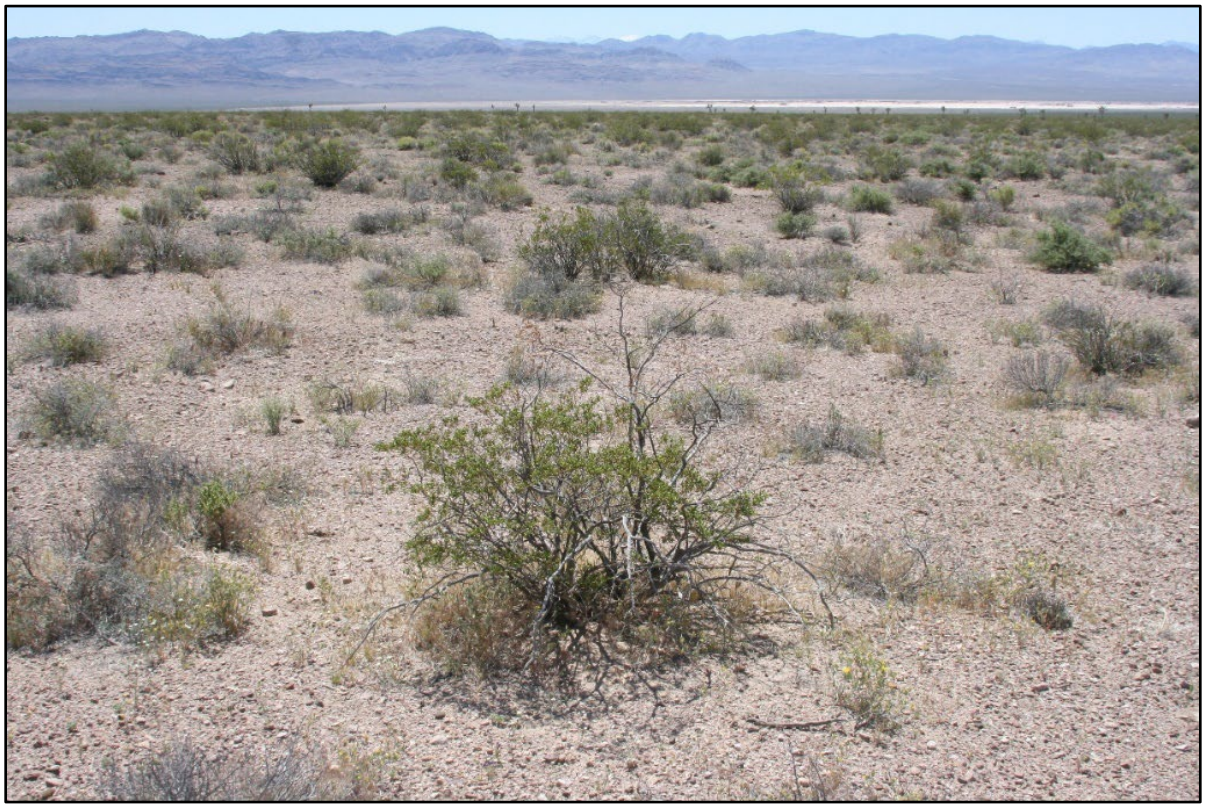

Figure 7-11. Reference area near the Area 5 Radioactive Waste Management Complex.

(Photo by D.B. Hall, May 13, 2023)

Table 7-6. Plant density (plants/m^2) by species and lifeform on the reference area, June 2021 (drought conditions) and May 2023 (above-normal precipitation) (S = seedlings, Total = mature plants and seedlings combined).

Lifeform/Species	Reference Area (2021)	Reference Area (2023)
Perennial Shrubs		
White bursage	0.08	0.09
Fourwing saltbush	0.00	0.00
Shadscale saltbush	0.19	0.17; 0.01 S; 0.18 Total
Cattle saltbush	0.00	0.00
Nevada jointfir	0.06	0.06
Winterfat	0.01	0.02
Creosote bush	0.04	0.03
Littleleaf ratany (Not seeded)	0.43	0.31
Shockley's goldenhead (Not seeded)	0.01	0.00
Water jacket (Not seeded)	0.02	0.02
Spiny hopsage (Not seeded)	0.00	0.01
TOTAL	**0.84**	**0.71; 0.01 S; 0.72 Total**
Perennial Grasses		
Indian ricegrass	0.10	0.07; 0.26 S; 0.33 Total
Squirreltail	0.00	0.00
TOTAL	**0.10**	**0.07; 0.26 S; 0.33 Total**
Perennial Forbs		
Desert marigold	0.00	0.00
Palmer's penstemon	0.00	0.00
Desert globemallow	0.00	0.00
Desert pepperweed	0.00	0.00
Astragalus (Not seeded)	0.00	0.08
TOTAL	**0.00**	**0.08**
TOTAL PERENNIALS	**0.94**	**0.86; 0.27 S; 1.13 Total**
Annual Grasses		
Arabian schismus	0.00	14.88
Cheatgrass	0.01	2.04
Red brome	0.00	1.17
Unknown brome	0.00	0.00
Sixweeks fescue	0.00	2.21
Common wheat	0.00	0.00
TOTAL	**0.01**	**20.30**
Annual Forbs		
Saltlover	0.00	0.00
Roundleaf oxytheca	0.16	0.68
Others	0.00	30.03
TOTAL	**0.16**	**30.71**
TOTAL ANNUALS	**0.17**	**51.01**

Table 7-7. Percent cover by species and category on the reference area, June 2021 (drought conditions) and May 2023 (above-normal precipitation).

Category/Species	% Cover (2021)	% Cover (2023)
Perennial Shrubs		
White bursage	0.4	0.1
Shadscale saltbush	2.4	2.4
Nevada jointfir	1.1	1.1
Spiny hopsage	0.1	0.0
Winterfat	0.1	0.1
Littleleaf ratany	3.3	3.7
Creosote bush	1.1	2.3
Water jacket	0.3	0.9
Beaked spiny polygala	0.0	0.1
TOTAL	**8.8**	**10.7**
Perennial Grasses		
Indian ricegrass	0.1	0.2
TOTAL	**0.1**	**0.2**
Perennial Forbs Total	**0.0**	**0.0**
TOTAL PERENNIALS	**8.9**	**10.9**
Annual Grasses		
Cheatgrass	0	0.4
Red brome	0	0.2
Arabian schismus	0	1.4
TOTAL	**0.0**	**2.0**
Annual Forbs		
Nevada cryptantha	0.0	0.2
Esteve's pincushion	0.0	0.4
Gilia species	0.0	0.2
Devil's spineflower	0.0	0.3
Pacific blazingstar	0.0	1.0
Roundleaf oxytheca	0.0	0.2
Smooth desertdandelion	0.0	0.1
Purplemat	0.0	0.1
TOTAL	**0.0**	**2.5**
TOTAL ANNUALS	**0.0**	**4.5**
TOTAL VEGETATIVE COVER	**8.9**	**15.4**
Rock (>25 cm)	0.0	0
Cobble (8-25 cm)	0.2	0
Gravel (0.5-8 cm)	38.5	61.6
Bare ground	33.8	15.3
Litter	18.6	7.7
ABIOTIC TOTAL	**91.1**	**84.6**

7.4 Cell 21 (CAU 577) Revegetation and Monitoring

This closure cover (2.8 ha) was revegetated during spring 2023 in conjunction with North North Cover (CAU 111), and plant density was measured in June 2023 along eight, permanent, 100-m long transects. Numerous creosote bush and white bursage seedlings germinated after summer rains in 2023 alongside good plant densities from seeding. Nevertheless, it was decided to plant white bursage and creosote bush transplants on this cover cap to increase plant density and cover. Plant density and percent cover were measured in June 2024 along the same transects as in 2023. Due to high numbers, Arabian schismus and saltlover density was counted in the upper right quadrant (0.25 m^2) and then multiplied by four to get number of plants/m^2. New seedlings encountered in 2024 were differentiated from mature plants to evaluate the seedbank effect. Density and cover results are found in Tables 7-8 and 7-9, respectively, along with density data from 2023 and the 2023 reference area density and cover data. Overall perennial plant density increased from 2023 to 2024 largely due to the influx of new seedlings, especially creosote bush and white bursage, but seedlings of eight other species were also documented. Nevada jointfir, creosote bush, white bursage, and Indian ricegrass had the highest densities, and all 12 seeded species were found, which is encouraging. Of particular interest is the relative high density of white bursage and creosote bush that can be difficult to germinate and establish from seed. The high densities of saltlover and Russian thistle is somewhat worrisome and will be monitored for impacts to survival of seeded plants. Overall, seeded plant densities are very high (Figure 7-12) and will hopefully establish and persist over the next several years.

Percent perennial plant cover on the closure cover exceeded cover in the reference area (12.8 versus 10.9). Nevada jointfir, Indian ricegrass, desert marigold, and white bursage comprised most of the perennial plant cover. Saltlover and Russian thistle had cover values that may be problematic if they continue to increase, and they will be monitored and remediated if necessary.

Figure 7-12. Vegetation at Cell 21 (CAU 577) closure cover.

(Photo by D.B. Hall, April 18, 2024)

Table 7-8. Plant density (plants/m^2) by species and lifeform on Cell 21 (CAU 577) compared to the reference area (S = seedlings, T = transplants, Total = mature plants, seedlings, and transplants combined).

Lifeform/Species	Cell 21 (2023)	Cell 21 (2024)	Reference Area (2023)
Perennial Shrubs			
White bursage	0.36 S	0.89; 2.88 S; 0.03 T; 3.80 Total	0.09
Fourwing saltbush	0.18 S	0.19; 0.12 S; 0.31 Total	0.00
Shadscale saltbush	0.09 S	0.040	0.17; 0.01 S; 0.18 Total
Cattle saltbush	0.70 S	0.71; 0.02 S; 0.73 Total	0.00
Nevada jointfir	7.81 S	6.84; 0.13 S; 6.97 Total	0.06
Winterfat	0.05 S	0.03; 0.01 S; 0.04 Total	0.02
Creosote bush	0.03 S	0.13; 6.17 S; 0.06 T; 6.36 Total	0.03
Littleleaf ratany (not seeded)	0.00	0.000	0.31
Spiny hopsage (not seeded)	0.00	0.000	0.01
Water jacket (not seeded)	0.00	0.000	0.02
TOTAL	**9.22 S**	**8.83; 9.33 S; 0.09 T; 18.22 Total**	**0.71; 0.01 S; 0.72 Total**
Perennial Grasses			
Indian ricegrass	8.53 S	2.51; 1.21 S; 3.72 Total	0.07; 0.26 S; 0.33 Total
Squirreltail	0.11 S	0.010	0.00
TOTAL	**8.64 S**	**2.52; 1.21 S; 3.73 Total**	**0.07; 0.26 S; 0.33 Total**
Perennial Forbs			
Desert marigold	1.19 S	1.00; 0.03 S; 1.03 Total	0.00
Palmer's penstemon	0.02 S	0.01; 0.01 S; 0.02 Total	0.00
Desert globemallow	0.01 S	0.03; 0.03 S; 0.06 Total	0.00
Astragalus spp.	0.00	0.00	0.08
TOTAL	**1.22 S**	**1.04; 0.07 S; 1.11 Total**	**0.08**
TOTAL PERENNIALS	**19.08 S**	**12.39; 10.61 S; 0.09 T; 23.09 Total**	**0.86; 0.27 S; 1.13 Total**
Annual Grasses			
Arabian schismus	0.00	2.85	14.88
Cheatgrass	0.00	0.01	2.04
Red brome	0.00	0.01	1.17
Sixweeks fescue	0.00	0.00	2.21
TOTAL	**0.00**	**2.86**	**20.30**
Annual Forbs			
Saltlover	0.30	121.58	0.00
Russian thistle	0.04	20.46	0.00
Others	0.01	0.25	30.70
TOTAL	**0.35**	**142.29**	**30.71**
TOTAL ANNUALS	**0.35**	**145.15**	**50.71**

In March 2024, 2,077 gallon-size transplants (1,044 creosote bush, 1,033 white bursage) were planted at Cell 21. The site was irrigated with 19.1 mm on April 30 and May 1 to increase transplant survival. Short-term transplant survival was evaluated on April 30. Plants were counted as either dead or alive and a vigor rating (0 – Dead, 1 – Barely alive, 2 – Moderate, 3 – Thriving, and 4 – Excellent) was assigned. Creosote bush and white bursage survival was 85% and 70%, respectively, and the average plant vigor was 1.6 and 1.5, respectively.

Table 7-9. Percent plant cover by species and category on Cell 21 (CAU 577) compared to the reference area.

Category/Species	Cell 21 (2024)	Reference Area (2023)
Perennial Shrubs		
White bursage	1.2; 0.3 S; 1.5 Total	0.1
Fourwing saltbush	0.4	0.0
Shadscale saltbush	0.0	2.4
Cattle saltbush	0.5	0.0
Nevada jointfir	5.3	1.1
Winterfat	0.0	0.1
Creosote bush	0.9 S	2.3
Littleleaf ratany (Not seeded)	0.0	3.7
Water jacket (Not seeded)	0.0	0.9
Beaked spiny polygala (Not seeded)	0.0	0.1
TOTAL	**7.4; 1.2 S; 8.6 Total**	**10.7**
Perennial Grasses		
Indian ricegrass	2.3	0.2
Squirreltail	0.1	0.0
TOTAL	**2.4**	**0.2**
Perennial Forbs		
Desert marigold	1.8	0.0
TOTAL	**1.8**	**0.0**
TOTAL PERENNIALS	**11.6; 1.2 S; 12.8 Total**	**10.9**
Annual Grasses		
Arabian schismus	0.0	1.4
Cheatgrass	0.0	0.4
Red brome	0.0	0.2
TOTAL	**0.0**	**2.0**
Annual Forbs		
Saltlover	6.3	0.0
Russian thistle	1.5	0.0
Other annual forbs	0.4	2.5
TOTAL ANNUALS	**8.2**	**4.5**
TOTAL VEGETATIVE COVER	**21.0**	**15.4**
Rock (>25 cm)	0.1	0.0
Cobble (8-25 cm)	1.3	0.0
Gravel (0.5-8 cm)	34.9	61.6
Bare ground	15.1	15.3
Straw mulch	24.4	0.0
Litter	3.5	7.7
TOTAL ABIOTIC	**79.3**	**84.6**

7.5 Cells 19/20 (CAU 577) Revegetation and Monitoring

Revegetation of Cells 19/20 (CAU 577) (4.8 ha) was accomplished during the spring of 2022. In March 2023, approximately 2,715 creosote bush and 2,453 white bursage plants were transplanted. Revegetation activities at this site in 2024 included monitoring plant density and cover and evaluating transplant survival.

Plant density was monitored in late May/early June in 2022, 2023, and 2024 to evaluate revegetation success. Percent plant cover was also measured in 2024. Thirteen, 100-m long transects were established uniformly across the cover cap and ten of these were randomly selected to be sampled in a similar manner as the reference area. Sampling also occurred along a 100-m long transect that was not irrigated for comparison. Due to high numbers, Arabian schismus and saltlover density was counted in the upper right quadrant (0.25 m^2) and then multiplied by four to get number of plants/m^2. New seedlings encountered in 2023 and 2024 were differentiated from mature plants to evaluate the seedbank effect. Plant density and percent cover results are found in Tables 7-10 and 7-11, respectively. Transplant survival was monitored in early May 2024. Transplants were counted as either dead or alive and a vigor rating (0 – Dead, 1 – Barely alive, 2 – Moderate, 3 – Thriving, and 4 – Excellent) was assigned.

Overall, perennial plant density declined by slightly more than half compared to 2023 but is still four times greater than in the reference area and all 12 seeded species were recorded. A lot fewer seedlings were observed in 2024 compared to 2023 even though precipitation was well above average. This suggests that most of the viable seed has germinated during the first two years. Arabian schismus and saltlover densities drastically increased which may make it difficult for perennials to compete and establish. These two species will be monitored and remediated if necessary. Perennial plant density in the non-irrigated area was 1.70 plants/m^2 with only five seeded species present compared to 4.71 plants/m^2 in the irrigated area with all 12 seeded species present.

Percent perennial plant cover is nearly 80% of cover in the reference area with 10 seeded species recorded. Arabian schismus dominates annual plant cover with some saltlover. Due to its shallow root system and short life span, Arabian schismus is believed to not compete with the deep-rooted perennials as much as saltlover. Percent perennial plant cover in the non-irrigated area was only 2.0, well below cover in the irrigated area (8.5) and the reference area (10.9). Perennial plant density was a little higher in the non-irrigated area than the reference area (1.6 versus 1.1 plants/m^2). Irrigation is still highly recommended to increase species richness and perennial plant cover. Overall transplant survival was 87.1% and 72.1% for creosote bush and white bursage, respectively. Average plant vigor was 2.2 for creosote bush and 2.5 for white bursage.

Table 7-10. Plant density (plants/m^2) by species and lifeform on Cells 19/20 (CAU 577) compared to the reference area (S = seedlings, T = transplants, Total = mature plants, seedlings, and transplants combined).

Lifeform/Species	19/20 Closure Cover (2022)	19/20 Closure Cover 2023	19/20 Closure Cover 2024	Reference Area 2023
Perennial Shrubs				
White bursage	0.004 S	0.010 S, 0.050 T; 0.060 Total	0.010, 0.050 S, 0.040 T; 0.100 Total	0.085
Fourwing saltbush	0.004 S	0.225, 0.025 S; 0.245 Total	0.220, 0.005 S; 0.225 Total	0.000
Shadscale saltbush	0.000	0.400 S; 0.400 Total	0.480	0.170; 0.010 S; 0.180 Total
Cattle saltbush	0.004 S	0.035, 0.015 S; 0.050 Total	0.050	0.000
Nevada jointfir	0.762 S	0.890, 1.530 S; 2.42 Total	2.420	0.060
Winterfat	0.008 S	0.050	0.005	0.020
Creosote bush	0.008 S	0.040S, 0.060T, 0.100 Total	0.015, 0.020 S, 0.110 T; 0.145 Total	0.025
Littleleaf ratany (not seeded)	0.000	0.000	0.000	0.305
Spiny hopsage (not seeded)	0.000	0.000	0.000	0.005
Water jacket (not seeded)	0.000	0.000	0.000	0.015
TOTAL	**0.790 S**	**1.200, 2.02 S, 0.110 T; 3.330 Total**	**3.200, 0.075 S, 0.150 T; 3.425 Total**	**0.685; 0.010 S; 0.695 Total**
Perennial Grasses				
Indian ricegrass	0.935 S	0.580, 4.310 S; 4.89 Total	0.840, 0.005 S; 0.845 Total	0.070; 0.260 S; 0.330 Total
Squirreltail	4.442 S	1.065, 0.450 S; 1.515 Total	0.290	0.000
TOTAL	**5.377 S**	**1.645, 4.760 S; 6.405 Total**	**1.130, 0.005 S; 1.135 Total**	**0.070; 0.260 S; 0.330 Total**
Perennial Forbs				
Desert marigold	0.000	0.005, 0.030 S; 0.035 Total	0.040	0.000
Palmer's penstemon	0.000	0.005, 0.205 S; 0.210 Total	0.045	0.000
Desert globemallow	0.000	0.005	0.045, 0.020 S; 0.065 Total	0.000
Astragalus spp.	0.000	0.010	0.000	0.075
TOTAL	**0.000**	**0.025, 0.235 S; 0.260 Total**	**0.130, 0.020S; 0.150 Total**	**0.075**
TOTAL PERENNIALS	**6.167 S**	**2.87, 7.015 S, 0.110 T; 9.995 Total**	**4.460, 0.100 S; 0.150 T; 4.710 Total**	**0.830; 0.27 S; 1.100 Total**
Annual Grasses				
Arabian schismus	1.631	19.680	175.340	14.880
Cheatgrass	0.004	0.030	0.010	2.035
Red brome	0.004	0.020	0.000	1.170
Unknown brome	0.004	0.000	0.000	0.000
Sixweeks fescue	0.000	0.575	0.000	2.210
Common wheat	0.008	0.000	0.000	0.000
TOTAL	**1.651**	**20.305**	**175.350**	**20.295**
Annual Forbs				
Saltlover	0.004	2.740	70.300	0.000
Russian thistle	0.004	0.140	2.650	0.000
Roundleaf oxytheca	0.000	0.000	0.000	0.675
Others	0.000	1.075	0.015	30.025
TOTAL	**0.008**	**3.955**	**72.965**	**30.700**
TOTAL ANNUALS	**1.659**	**24.26**	**248.315**	**50.995**

Table 7-11. Percent plant cover by species and category on Cells 19/20 (CAU 577) compared to the reference area.

Category/Species	19/20 Closure Cover (2024)	Reference Area (2023)
Perennial Shrubs		
White bursage	0.4	0.1
Fourwing saltbush	1.3	0.0
Shadscale saltbush	1.2	2.4
Cattle saltbush	0.9	0.0
Nevada jointfir	2.4	1.1
Winterfat	0.0	0.1
Creosote bush	0.6	2.3
Littleleaf ratany (Not seeded)	0.0	3.7
Water jacket (Not seeded)	0.0	0.9
Beaked spiny polygala (Not seeded)	0.0	0.1
TOTAL	**6.8**	**10.7**
Perennial Grasses		
Indian ricegrass	0.9	0.2
Squirreltail	0.4	0.0
TOTAL	**1.3**	**0.2**
Perennial Forbs		
Desert marigold	0.1	0.0
Palmer's penstemon	0.2	0.0
Freckled milkvetch	0.1	0.0
TOTAL	**0.4**	**0.0**
TOTAL PERENNIALS	**8.5**	**10.9**
Annual Grasses		
Arabian schismus	21.9	1.4
Cheatgrass	0.0	0.4
Red brome	0.0	0.2
TOTAL	**21.9**	**2.0**
Annual Forbs		
Saltlover	2.9	0.0
Russian thistle	0.3	0.0
Other annual forbs	0.0	2.5
TOTAL	**3.2**	**2.5**
TOTAL ANNUALS	**25.1**	**4.5**
TOTAL VEGETATIVE COVER	**33.6**	**15.4**
Cobble (8-25 cm)	0.5	0.0
Gravel (0.5-8 cm)	37.0	61.6
Bare ground	11.9	15.3
Straw mulch	0.0	0.0
Litter	17.0	7.7
TOTAL ABIOTIC	**66.4**	**84.6**

7.6 CAU 577 East and West Cover Cap Monitoring

Revegetation of East (5.2 ha) and West (7.0 ha) Closure Covers (CAU 577) was accomplished during the spring of 2021. Activities during 2024 focused on sampling plant density and percent cover on these closure covers. Sampling occurred during late May/early June. Plant density was monitored on ten, randomly selected transects on East Closure Cover, seven on west-west portion of West Closure Cover, and six on west-east portion of West Closure Cover following the same protocol as on the reference area. Due to high numbers, Arabian schismus and saltlover density was counted in the upper right quadrant (0.25 m^2) and then multiplied by four to get number of plants/m^2. New seedlings encountered in 2022–2024 were differentiated from mature plants to evaluate the seedbank effect. Percent cover was also measured on the same transects as plant density following the same methods as in the reference area.

Results from plant density counts on the East Closure Cover (Table 7-12, Figure 7-13) showed a decline in perennial plant densities each successive year from 2021 to 2023 which was expected due to competition from the high number of plants that had germinated the first year. Total perennial plant density actually increased between 2023 and 2024, largely due to an increase in white bursage and creosote bush seedlings that germinated from the late summer/early fall rains in 2023. Perennial plant density was substantially higher on the closure cover than in the reference area (5.38 versus 1.13). Six shrubs and one perennial forb were found with cattle saltbush being the most abundant. Even though Indian ricegrass was abundant the first year, it did not persist, and no perennial grasses were recorded in 2024. Annual forbs were found in much higher densities on the reference area compared to the closure cover with significantly higher species richness. High densities of Arabian schismus were recorded on the closure cover again this year, nearly double that found in 2023, and much higher than on the reference area. Most of these plants were very small and it does not appear that the high density negatively impacted seeded plant density. Arabian schismus has a very shallow root system, low biomass, and tends to go dormant quickly so it does not deplete soil moisture like other invasives such as bromes (*Bromus* spp.) and saltlover. In addition, roots of the seeded plants occurred deeper in the soil profile than roots of Arabian schismus and thus were not competing for the same soil moisture.

The West Cover Cap (Figure 7-14) was divided into the west-east and west-west portions due to different germination irrigation amounts applied during March 2021. The west-east and west-west received 50.8 mm and 31.8 mm of irrigation, respectively. Perennial plant density in the west-east portion was higher than in the west-west portion as it has been since 2021 which is attributed to the increased germination irrigation in 2021 (Table 7-13). Perennial plant density on both portions were slightly higher in 2024 than in 2023 largely due to creosote bush and white bursage seedlings that germinated from the late summer/early fall rains in 2023. Perennial plant density on both portions was higher than that found on the reference area. Six shrubs, one perennial grass, and two perennial forbs were found with cattle saltbush and Nevada jointfir being the most abundant. Indian ricegrass declined significantly but was still found in low densities. Annual forbs were found in much higher densities on the reference area compared to the closure cover with significantly higher species richness. Saltlover was found in moderate densities on the west-west portion with relatively few on the west-east portion. High densities of Arabian schismus were recorded on the closure cover, much higher than on the reference area.

Average percent cover of perennial species on the East Closure Cover (Table 7-14) was nearly double that measured in the reference area, almost twice as high in 2024 compared to 2023, and dominated by cattle saltbush with some fourwing saltbush and a little bit of shadscale saltbush and white bursage. Littleleaf ratany, shadscale saltbush, and creosote bush provided most of the perennial cover in the reference area. Arabian schismus cover was nearly equal to total perennial cover on the East Closure Cover, and saltlover cover was zero. The overall decline in plant density and the substantial increase in plant cover are signs that the vegetation on the closure cover is establishing as the plants grow and mature.

Table 7-12. Plant density (plants/m^2) by lifeform and species for the East Closure Cover and the reference area.

Lifeform/Species	East Closure Cover (2021)	East Closure Cover (2022)	East Closure Cover (2023)	East Closure Cover (2024)	Reference Area (2023)
Perennial Shrubs					
White bursage	0.32 S	0.16	0.04	0.09, 0.50 S; 0.59 Total	0.09
Fourwing saltbush	0.71 S	0.62	0.49	0.36	0.00
Shadscale saltbush	0.02 S	0.01	0.01	0.00	0.17; 0.01 S; 0.18 Total
Cattle saltbush	4.45 S	4.34	3.68	3.88	0.00
Nevada jointfir	2.00 S	1.36	0.49; 0.01 S; 0.50 Total	0.40	0.06
Winterfat	0.14 S	0.06	0.03	0.02	0.02
Creosote bush	0.01 S	0.01	0.01	0.01, 0.04 S, 0.05 Total	0.03
Littleleaf ratany (Not seeded)	0.00	0.00	0.00	0.00	0.31
Water jacket (Not seeded)	0.00	0.00	0.00	0.00	0.02
Spiny hopsage (Not seeded)	0.00	0.00	0.00	0.00	0.01
TOTAL	**7.65 S**	**6.56**	**4.75; 0.01 S; 4.76 Total**	**4.76; 0.54 S; 5.30 Total**	**0.71; 0.01 S; 0.72 Total**
Perennial Grasses					
Indian ricegrass	4.32 S	0.13	0.00	0.00	0.07; 0.26 S; 0.33 Total
Squirreltail	3.14 S	0.00	0.00	0.00	0.00
TOTAL	**7.46 S**	**0.13**	**0.00**	**0.00**	**0.07; 0.26 S; 0.33 Total**
Perennial Forbs					
Desert marigold	4.01 S	0.59	0.01	0.00	0.00
Palmer's penstemon	0.00	0.00	0.00	0.00	0.00
Desert globemallow	0.00	0.00	0.00	0.02; 0.06 S; 0.08 Total	0.00
Desert pepperweed	0.00	0.00	0.00	0.00	0.00
Astragalus (Not seeded)	0.00	0.00	0.00	0.00	0.08
TOTAL	**4.01 S**	**0.59**	**0.01**	**0.08**	**0.08**
TOTAL PERENNIALS	**19.12 S**	**7.28**	**4.76; 0.01 S; 4.77 Total**	**4.78; 0.60 S; 5.38 Total**	**0..86; 0.27 S; 1.13 Total**
Annual Grasses					
Arabian schismus	25.89	139.60	118.92	231.94	14.88
Cheatgrass	0.59	0.00	1.39	0.38	2.04
Red brome	0.11	0.00	0.09	0.01	1.17
Unknown brome	0.00	0.02	0.00	0.00	0.00
Sixweeks fescue	1.03	0.00	0.18	0.00	2.21
Common wheat	0.00	0.00	0.00	0.00	0.00
TOTAL	**27.62**	**139.62**	**120.58**	**232.33**	**20.30**
Annual Forbs					
Saltlover	0.20	0.55	0.86	0.00	0.00
Others	0.16	0.01	0.25	0.05	30.71
TOTAL	**0.36**	**0.56**	**1.11**	**0.05**	**30.71**
TOTAL ANNUALS	**27.98**	**140.18**	**121.69**	**232.38**	**51.01**

Similar patterns were observed on the west-east and west-west portions of the West Closure Cover with perennial cover doubling between 2023 and 2024 (Table 7-14) and double that measured in the reference area. Cattle saltbush was dominant followed by fourwing saltbush and Nevada jointfir. Percent cover of Arabian schismus was fairly high, especially on the west-east portion and higher than in the reference area. Saltlover cover was greatly reduced. Even though the East and West Closure covers have not been irrigated since fall 2021, percent perennial cover exceeds 20% which is attributed to the above-average winter/spring precipitation received during 2022–2023 and 2023–2024.

Figure 7-13. Vegetation on East Closure Cover, spring 2024.

(Photo by D.B. Hall, April 17, 2024)

Figure 7-14. Vegetation on West Closure Cover, spring 2024.

(Photo by D.B. Hall, April 17, 2024)

Table 7-13. Plant density (plants/m^2) by lifeform and species for the West Closure Cover (CAU 577) and the reference area.

Lifeform/Species	West-west Cover (2021)	West-west Cover (2022)	West-west Cover (2023)	West-west Cover (2024)	West-east Cover (2021)	West-east Cover (2022)	West-east Cover (2023)	West-east Cover (2024)	Reference Area (2023)
Perennial Shrubs									
White bursage	0.08 S	0.06	0.03	0.04, 0.01 S; 0.05 Total	0.33 S	0.16	0.06	0.07, 0.48 S; 0.55 Total	0.09
Fourwing saltbush	0.43 S	0.35	0.26; 0.01 S; 0.27 Total	0.26	0.72 S	0.51	0.40	0.33	0.00
Shadscale saltbush	0.01 S	0.02	0.01	0.00	0.03 S	0.01	0.01	0.00	0.17; 0.01 S; 0.18 Total
Cattle saltbush	1.96 S	1.67	1.43; 0.06 S; 1.49 Total	1.61, 0.07 S; 1.68 Total	3.20 S	2.70	2.28	2.18	0.00
Nevada jointfir	2.06 S	1.47	0.89; 0.01 S; 0.90 Total	0.74	2.24 S	1.68	1.03	0.84	0.06
Winterfat	0.06 S	0.03	0.03	0.01	0.10 S	0.03	0.03	0.03	0.02
Creosote bush	0.02 S	0.02	0.01	0.04 S; 0.04 Total	0.05 S	0.02	0.01	0.02, 0.03 S; 0.05 Total	0.03
Littleleaf ratany (Not seeded)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31
Shockley's goldenhead (Not seeded)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water jacket (Not seeded)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Spiny hopsage (Not seeded)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
TOTAL	**4.62 S**	**3.61**	**2.66; 0.08 S; 2.74 Total**	**2.66, 0.12 S; 2.78 Total**	**6.67 S**	**5.11**	**3.82**	**3.47, 0.51 S; 3.98 Total**	**0.71; 0.01 S; 0.72 Total**
Perennial Grasses									
Indian ricegrass	11.17 S	1.36	0.01	0.00	10.99 S	2.39	0.03	0.02	0.07; 0.26 S: 0.33 Total
Squirreltail	1.02 S	0.09	0.00	0.00	3.23 S	0.01	0.00	0.00	0.00
TOTAL	**12.19 S**	**1.45**	**0.01**	**0.00**	**14.22 S**	**2.40**	**0.03**	**0.02**	**0.07; 0.26 S: 0.33 Total**
Perennial Forbs									
Desert marigold	1.07 S	0.30	0.00	0.00	3.64 S	0.53	0.03	0.01; 0.02 S; 0.03 Total	0.00
Palmer's penstemon	0.00	0.00	0.00	0.00	0.06 S	0.00	0.00	0.00	0.00
Desert globemallow	0.01 S	0.01	0.00	0.01. 0.01 S; 0.02 Total	0.03 S	0.02	0.00	0.01; 0.02 S; 0.03 Total	0.00
Desert pepperweed	0.00	0.00	0.00	0.00	0.01 S	0.01	0.00	0.00	0.00
Astragalus (Not seeded)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
TOTAL	**1.08 S**	**0.31**	**0.00**	**0.02**	**3.74 S**	**0.56**	**0.03**	**0.02; 0.04 S; 0.06 Total**	**0.08**
TOTAL PERENNIALS	**17.89 S**	**5.37**	**2.67; 0.08 S; 2.75 Total**	**2.67; 0.13 S; 2.80 Total**	**24.63 S**	**8.07**	**3.88**	**3.51; 0.55 S; 4.06 Total**	**0.86; 0.27 S; 1.13 Total**
Annual Grasses									
Arabian schismus	2.37	0.26	22.57	99.74	39.39	0.75	94.57	175.07	14.88
Cheatgrass	0.06	0.00	0.04	0.02	0.68	0.19	3.06	1.27	2.04
Red brome	0.04	0.00	0.01	0.03	0.23	0.11	0.26	0.25	1.17
Unknown brome	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00
Sixweeks fescue	0.01	0.00	0.01	0.00	0.61	0.00	0.12	0.00	2.21
Common wheat	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
TOTAL	**2.47**	**0.26**	**22.63**	**99.79**	**40.92**	**1.19**	**98.01**	**176.59**	**20.30**
Annual Forbs									
Saltlover	0.69	10.61	31.86	55.17	0.61	2.46	4.07	1.49	0.00
Others	0.17	0.09	0.52	0.10	0.18	0.07	0.34	0.09	30.71
TOTAL	**0.86**	**10.70**	**32.38**	**55.27**	**0.79**	**2.53**	**4.41**	**1.58**	**30.71**
TOTAL ANNUALS	**3.33**	**10.96**	**55.01**	**155.06**	**41.71**	**3.72**	**102.42**	**178.17**	**51.01**

Table 7-14. Average percent plant cover by species and category for the East and West Closure Covers (CAU 577) and the reference area.

	East Cover			West East Cover			West West Cover			Reference Area
Category/Species	2022 Average %Cover	2023 Average %Cover	2024 Average % Cover	2022 Average %Cover	2023 Average %Cover	2024 Average %Cover	2022 Average %Cover	2023 Average %Cover	2024 Average %Cover	2023 Average %Cover
Perennial Shrubs										
White bursage	0.00	0.00	0.10	0.00	0.00	0.00	0.10	0.00	0.00	0.10
Fourwing saltbush	0.53	1.00	2.90	0.80	0.67	3.00	0.80	1.00	2.40	0.00
Shadscale saltbush	0.00	0.00	0.30	0.10	0.17	0.00	0.00	0.00	0.00	2.40
Cattle saltbush	5.53	11.30	17.30	2.60	9.67	18.67	3.50	11.00	17.00	0.00
Nevada jointfir	0.07	0.00	0.00	0.20	0.50	0.50	0.50	0.57	1.60	1.10
Winterfat	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.10
Creosote bush	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.30
Littleleaf ratany (Not seeded)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.70
Water jacket (Not seeded)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
Beaked spiny polygala (Not seeded)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
TOTAL	**6.13**	**12.30**	**20.60**	**3.70**	**11.01**	**22.34**	**4.90**	**12.57**	**21.00**	**10.70**
Perennial Grasses										
Indian ricegrass	0.00	0.00	0.00	2.00	0.00	0.00	0.80	0.00	0.00	0.20
TOTAL	**0.00**	**0.00**	**0.00**	**2.00**	**0.00**	**0.00**	**0.80**	**0.00**	**0.00**	**0.20**
Perennial Forbs										
Desert marigold	0.07	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	**0.07**	**0.00**	**0.00**	**0.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
TOTAL PERENNIALS	**6.20**	**12.30**	**20.60**	**5.80**	**11.01**	**22.34**	**5.70**	**12.57**	**21.00**	**10.90**
Annual Grasses										
Arabian schismus	16.47	10.30	17.40	8.70	6.00	16.50	0.20	2.00	6.10	1.40
Cheatgrass	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.40
Red brome	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.20
TOTAL	**16.47**	**10.30**	**17.50**	**8.80**	**6.00**	**16.50**	**0.20**	**2.00**	**6.10**	**2.00**
Annual Forbs										
Saltlover	0.13	0.30	0.00	0.10	1.17	0.00	0.60	3.14	0.90	0.00
Russian thistle	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00
Other annual forbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50
TOTAL	**0.13**	**0.30**	**0.00**	**0.10**	**1.34**	**0.00**	**0.60**	**3.14**	**0.90**	**2.50**
TOTAL ANNUALS	**16.60**	**10.60**	**17.50**	**8.90**	**7.34**	**16.50**	**0.80**	**5.14**	**7.00**	**4.50**
TOTAL VEGETATIVE COVER	**22.80**	**22.90**	**38.10**	**14.70**	**18.35**	**38.84**	**6.50**	**17.71**	**28.00**	**15.40**
Rock (>25 cm)	0.00	0.10	0.10	0.00	0.17	0.00	0.20	0.14	0.00	0.00
Cobble (8-25 cm)	0.33	0.30	0.90	0.60	2.17	0.33	0.20	0.43	0.60	0.00
Gravel (0.5-8 cm)	31.53	52.20	35.30	27.90	40.50	47.17	45.50	44.86	41.30	61.60
Bare ground	16.47	11.40	14.80	16.50	17.33	3.83	14.40	23.00	20.70	15.30
Straw mulch	19.00	4.20	2.80	30.60	13.50	1.50	24.80	8.86	1.70	0.00
Total Litter	9.87	8.90	8.00	9.70	8.00	8.33	8.40	5.00	7.70	7.70
TOTAL ABIOTIC	**77.20**	**77.10**	**61.90**	**85.30**	**81.67**	**61.16**	**93.50**	**82.29**	**72.00**	**84.60**

7.7 Cell 18 Closure Cover Revegetation and Monitoring

Revegetation of Cell 18 Closure Cover (1.8 ha) was done in fall 2020. Activities in 2024 included transplanting creosote bush and white bursage plants and sampling to determine transplant survival, plant density, and percent cover.

7.7.1 Transplant Survival

Approximately 3,850 plants (1,461 creosote bush, 2,389 white bursage) were transplanted in April 2021. Due to low first year survival, an additional 4,500 plants (1,200 creosote bush, 3,300 white bursage) were transplanted in April 2022. In March 2024, 2,107 plants (1,054 creosote bush, 1,053 white bursage) were transplanted. Thus, a total of 10,457 transplants (3,715 creosote bush, 6,742 white bursage) have been planted at Cell 18. The area was divided into six separate parcels with various treatments (Figure 7-15). These included North Acre Cap, South Acre Cap, East Cap, North Edge, South Edge, and Southeast Triangle. North Acre Cap is a one-acre parcel on the north side of the closure cover that was fully irrigated. South Acre Cap is a one-acre parcel on the south side of the closure cover that was fully irrigated. These two areas were originally seeded with slightly different seed mixes to compare germination and establishment of locally collected white bursage and creosote bush seed (North Acre) with commercially purchased seed (South Acre). Otherwise, these two areas were alike. East Cap is a 0.8-acre parcel on the east edge of the cap and was fully irrigated. North Edge is on the side slope of the closure cover on the north side that was partially irrigated on the southern-third portion of the slope. South Edge is on the side slope of the closure cover on the southern side that was seeded by hand and partially irrigated using a water truck spraying the side slope opportunistically. Southeast Triangle is in the southeastern corner of the site, mostly off the closure cover, that was partially irrigated. North Acre Cap, South Acre Cap, and East Cap are all considered to be on the cover cap while North Edge, South Edge, and Southeast Triangle are off the cap. Transplants were planted in all areas during 2021 but only on the cover cap in 2022 and 2024.

In late April/early May 2023 and 2024, marked transplants were evaluated to determine transplant survival and assess vigor of surviving plants. Plants were counted as either dead or alive and a vigor rating (0 – Dead, 1 – Barely alive, 2 – Moderate, 3 – Thriving, and 4 – Excellent) was assigned. Percent survival and average vigor rating by species, year planted, and area were calculated (Table 7-15). Due to being drought-deciduous, it was difficult to determine if white bursage was dead or just dormant, whereas creosote bush is evergreen which made it easier to distinguish dead from living plants.

Sampling results in 2023 showed a combined species survival of 25.1% from the 2021 planting efforts including 28.7% and 21.4% survival of creosote bush (1.8 vigor) and white bursage (1.5 vigor); respectively. In 2024, combined species survival was 27.0% including 27.6% and 0.0% survival of creosote bush (1.4 vigor) and white bursage (0.0 vigor), respectively. Percent survival of both species was much higher on the cover cap than off the cover cap in 2023 (49.0 versus 11.7) and 2024 (55.3 versus 14.8) because of the different irrigation treatments. Average vigor was also higher on the cover cap than off the cover cap in both 2023 (2.1 versus 1.2) and 2024 (0.9 versus 0.5).

For the plants transplanted in 2022, combined species survival in 2023 was 16.9%: 21.4% for creosote bush (1.9 vigor) and 16.1% for white bursage (1.8 vigor). In 2024, combined species survival was 7.4%: 0.0% for creosote bush (0.0 vigor) and 7.4% for white bursage (2.3 vigor). Competition from high saltlover densities is thought to be a major factor in the relatively low transplant survival. Many of the creosote bush transplants were also quite small at the time they were planted. Survival after two months for plants transplanted in 2024 was 90.5% for creosote bush and 81.1% for white bursage (85.8% overall) and average vigor was 1.6 for each species. Several plants of both species, especially weak struggling ones, were covered in gnats which may be a possible source of mortality.

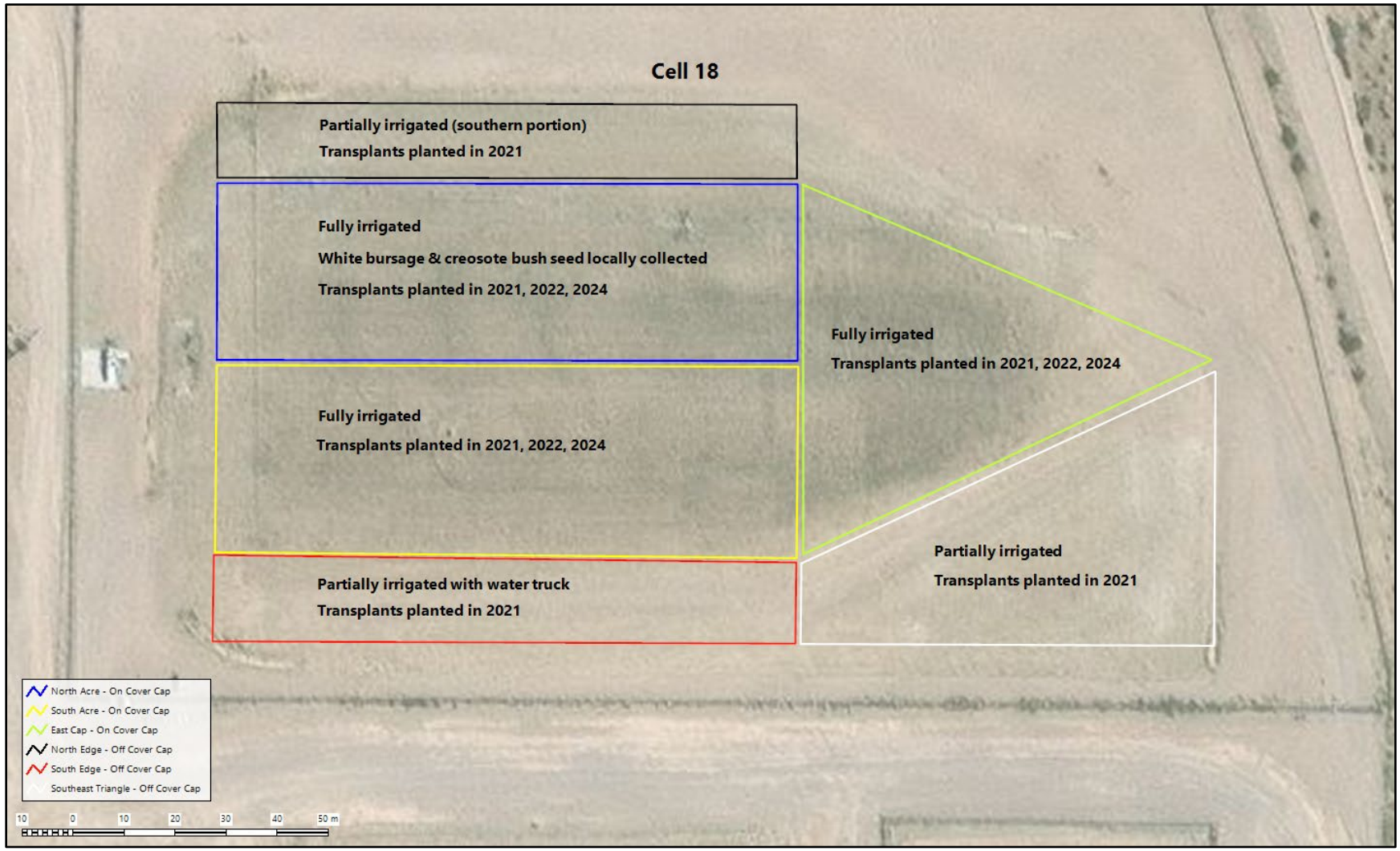

Figure 7-15. Cell 18 Closure Cover and associated treatments. All areas were seeded with the same commercially sourced seed mix, except for North Acre where locally collected white bursage and creosote bush seed was used. Irrigation using a wheel line was applied on the closure cover, with some partial irrigation off the closure cover, and some irrigation using a water truck along the southern edge.

Table 7-15. Results from 2023 and 2024 transplant survival monitoring including percent survival and average vigor information by area and species at Cell 18 Closure Cover. Blue, green, and peach shaded columns represent data from transplants planted in 2021, 2022, and 2024; respectively. NA = Not applicable because transplants were only planted on the cap area in 2022 and 2024.

Area/Species	2021 Plants % Survival (2023 Data)	2021 Plants % Survival (2024 Data)	2021 Plants Average Vigor (2023 Data)	2021 Plants Average Vigor (2024 Data)	2022 Plants % Survival (2023 Data)	2022 Plants % Survival (2024 Data)	2022 Plants Average Vigor (2023 Data)	2022 Plants Average Vigor (2024 Data)	2024 Plants % Survival (2024 Data)	2024 Plants Average Vigor (2024 Data)
North Acre (Creosote bush)	63.2	44.4	2	1	21.4	0	1.7	0	97.7	1.7
North Acre (White bursage)	32	0	2.5	0	23.1	11.8	1.8	2.8	89.4	1.7
South Acre (Creosote bush)	42.9	50	2	2	21.3	0	2	0	93.6	1.6
South Acre (White bursage)	25	0	1.7	0	6.1	3.2	1.7	1.8	84.8	1.6
East Cap (Creosote bush)	80	71.4	2.4	2.1	21.4	0	2	0	82.4	1.4
East Cap (White bursage)	50	0	1.8	0	16.9	5.7	1.8	2.2	71.4	1.5
North Edge (Creosote bush)	21.2	17.6	1.9	1.8	NA	NA	NA	NA	NA	NA
North Edge (White bursage)	0	0	0	0	NA	NA	NA	NA	NA	NA
South Edge (Creosote bush)	0	0	0	0	NA	NA	NA	NA	NA	NA
South Edge (White bursage)	15.4	0	1	0	NA	NA	NA	NA	NA	NA
Southeast Triangle (Creosote bush)	8.9	15.6	2.4	1.4	NA	NA	NA	NA	NA	NA
Southeast Triangle (White bursage)	14.8	0	1.8	0	NA	NA	NA	NA	NA	NA
TOTAL										
Creosote bush	28.7	27.6	1.8	1.4	21.4	0	1.9	0	90.5	1.6
White bursage	21.4	0.0	1.5	0.0	16.1	7.4	1.8	2.3	81.1	1.6
Cap	49.0	55.3	2.1	0.9	16.9	7.4	1.8	2.3	85.8	1.6
Off Cap	11.7	14.8	1.2	0.5	NA	NA	NA	NA	NA	NA
Creosote bush (Cap)	65.9	55.3	2.1	1.7	NA	NA	NA	NA	NA	NA
Creosote bush (Off Cap)	12.6	15.3	1.4	1.1	NA	NA	NA	NA	NA	NA
White bursage (Cap)	36.4	0.0	2.0	0.0	NA	NA	NA	NA	NA	NA
White bursage (Off Cap)	10.5	0.0	0.9	0.0	NA	NA	NA	NA	NA	NA

7.7.2 Plant Density and Percent Cover

Plant density and percent cover were measured in May 2024 along multiple 40-m long permanent transects that were established in each of the six aforementioned areas. A 1-m x 1-m quadrat was placed at seven locations, every five meters, on alternating sides of each transect and the number of plants, including from seed and transplants planted in 2021, 2022, and 2024, were counted by species. Due to high numbers, Arabian schismus and saltlover density was counted in the upper right quadrant (0.25 m^2) and then multiplied by four to get number of plants/m^2. New seedlings encountered in 2022-2024 were differentiated from mature plants to evaluate the seedbank effect. An average number of plants per square meter by species was then calculated for each area and summed for the areas on the cover cap (Table 7-16) and areas off the cover cap. Only the values for the cover cap are reported. Density data from 2021, 2022, and 2023 sampling are also included in Table 7-16. Percent cover was also measured with the optical cover scope following the same methods as in the reference area. Data from four points (45, 135, 225, and 315 degrees), every four meters, for a total of 40 points were recorded for each transect on the cover cap. Cover data were not collected off the cover cap. Average percent cover by species and category are reported in Table 7-17 and compared to the 2022 and 2023 values.

Perennial plant density on the cap was 0.76 plants/m^2 compared to 1.13 plants/m^2 in the reference area. This equates to 67% of perennial plant density in the reference area. Perennial plant density increased from 0.58 to 0.76 plants/m^2 between 2023 and 2024 which is mostly attributed to the additional transplants and a few creosote bush and white bursage seedlings. Additional transplants may be planted to increase plant density on the cover cap. Arabian schismus and saltlover densities were drastically lower in 2024 than in 2023 due to the pre-emergent herbicide Rejuvra applied in December 2023 (Hall and Perry 2024). Perennial plant density off the cover cap was a lot less than on the cover cap (0.15 versus 0.76 plants/m^2).

Perennial plant cover on the cover cap nearly tripled from 2.0 to 5.7 between 2023 and 2024, and percent cover of saltlover and Arabian schismus decreased from 19.6 to 0.8. These differences were due to the positive effects of the pre-emergent herbicide Rejuvra applied in December 2023 which prevented germination of saltlover and Arabian schismus. This created a competitive release for the perennials that did not have to compete with the invasive weeds for soil moisture. With the above-normal precipitation, the perennial shrubs were able to thrive. Perennial cover on the cover cap was 53% of cover in the reference area.

Table 7-16. Plant density (plants/m^2) by lifeform and species on the cap at Cell 18 Closure Cover and the reference area (S = seedlings, T = transplants, Total = mature plants, seedlings, and transplants combined).

Lifeform/Species	ON CAP Total (May 2021)	ON CAP Total (March 2022)	ON CAP Total (May 2023)	ON CAP Total (May 2024)	Reference Area 2023
Perennial Shrubs					
White bursage	0.05 S, 0.16 T, 0.21 Total	0.03 T	0.04 T	0.01, 0.01 S, 0.10 T; 0.12 Total	0.09
Fourwing saltbush	0.33 S	0.06	0.08	0.09	0.00
Shadscale saltbush	0.11 S	0.02	0.03; 0.02 S; 0.05 Total	0.03	0.17; 0.01 S; 0.18 Total
Cattle saltbush	0.13 S	0.08	0.03	0.05	0.00
Nevada jointfir	2.05 S	0.53; 0.04 S; 0.57 Total	0.31; 0.01 S; 0.32 Total	0.37	0.06
Winterfat	0.10 S	0.01	0.00	0.00	0.02
Creosote bush	0.01 S, 0.10 T, 0.11 Total	0.02 T	0.02 T	0.01 S, 0.09 T; 0.09 Total	0.03
Littleleaf ratany (Not seeded)	0.00	0.00	0.00	0.00	0.31
Shockley's goldenhead (Not seeded)	0.00	0.00	0.00	0.00	0.00
Water jacket (Not seeded)	0.00	0.00	0.00	0.00	0.02
Spiny hopsage (Not seeded)	0.00	0.00	0.00	0.00	0.01
TOTAL	**2.78 S; 0.26 T; 3.04 Total**	**0.70; 0.04 S; 0.05 T; 0.79 Total**	**0.45; 0.03 S; 0.06 T; 0.54 TOTAL**	**0.55, 0.02 S, 0.19 T; 0.76 Total**	**0.71; 0.01 S; 0.72 Total**
Perennial Grasses					
Indian ricegrass	7.51 S	0.08	0.04 S; 0.04 Total	0.00	0.07; 0.26 S; 0.33 Total
Squirreltail	2.25 S	0.00	0.00	0.00	0.00
TOTAL	**9.76 S**	**0.08**	**0.04 S; 0.04 Total**	**0.00**	**0.07; 0.26 S; 0.33 Total**
Perennial Forbs					
Desert marigold	0.21 S	0.00	0.00	0.00	0.00
Palmer penstemon	6.60 S	0.00	0.00	0.00	0.00
Desert globemallow	0.05 S	0.00	0.00	0.00	0.00
Freckled milkvetch (Not seeded)	0.01 S	0.00	0.00	0.00	0.08
TOTAL	**6.87 S**	**0.00**	**0.00**	**0.00**	**0.08**
TOTAL PERENNIALS	**19.41 S; 0.26 T; 19.67 Total**	**0.78; 0.04 S; 0.05 T; 0.87 Total**	**0.45; 0.07 S; 0.06 T; 0.58 TOTAL**	**0.55, 0.02 S, 0.19 T; 0.76 Total**	**0.86; 0.27 S; 1.13 Total**
Annual Grasses					
Arabian schismus	1.23	3.31	71.11	1.62	14.88
Cheatgrass	0.02	0.00	0.15	0.00	2.04
Red brome	0.01	0.00	0.07	0.00	1.17
Sixweeks fescue	0.00	0.00	0.00	0.00	2.21
TOTAL	**1.26**	**3.31**	**71.33**	**1.62**	**20.30**
Annual Forbs					
Saltlover (alive)	19.10	23.03	179.31	5.66	0.00
Saltlover (dead)	0.00	16.02	NA	NA	NA
Prickly Russian thistle	0.20	0.09	0.36	0.08	0.00
Other species	0.70	0.13	2.11	0.00	30.71
TOTAL	**20.00**	**39.27**	**181.78**	**5.74**	**30.71**
TOTAL ANNUALS	**21.26**	**42.58**	**221.05**	**7.36**	**51.01**

Table 7-17. Average percent cover by species/category in areas on the cap at Cell 18 Closure Cover and the reference area.

Category/Species	Cell 18 Cover Cap (March 2022)	Cell 18 Cover Cap (May 2023)	Cell 18 Cover Cap (May 2024)	Reference Area (May 2023)
Perennial Shrubs				
White bursage	0.0	0.0	0.1	0.1
Fourwing saltbush	0.0	0.4	1.1	0.0
Shadscale saltbush	0.0	0.1	0.7	2.4
Cattle saltbush	0.0	1.3	2.7	0.0
Nevada jointfir	0.0	0.1	0.8	1.1
Winterfat	0.0	0.0	0.1	0.1
Creosote bush	0.0	0.1	0.2	2.3
Littleleaf ratany (Not seeded)	0.0	0.0	0.0	3.7
Water jacket (Not seeded)	0.0	0.0	0.0	0.9
Beaked spiny polygala (Not seeded)	0.0	0.0	0.0	0.1
TOTAL	**0.0**	**2.0**	**5.7**	**10.7**
Perennial Grasses				
Indian ricegrass	0.0	0.0	0.0	0.2
Squirreltail	0.0	0.0	0.0	0.0
TOTAL	**0.0**	**0.0**	**0.0**	**0.2**
Perennial Forbs				
Desert marigold	0.0	0.0	0.0	0.0
Palmer's penstemon	0.0	0.0	0.0	0.0
Freckled milkvetch	0.0	0.0	0.0	0.0
TOTAL	**0.0**	**0.0**	**0.0**	**0.0**
TOTAL PERENNIALS	**0.0**	**2.0**	**5.7**	**10.9**
Annual Grasses				
Arabian schismus	0.3	6.2	0.0	1.4
Cheatgrass	0.0	0.0	0.0	0.4
Red brome	0.0	0.0	0.0	0.2
TOTAL	**0.3**	**6.2**	**0.0**	**2.0**
Annual Forbs				
Saltlover	0.0	13.4	0.8	0.0
Russian thistle	0.3	0.0	0.2	0.0
Other annual forbs	0.0	0.5	0.0	2.5
TOTAL	**0.3**	**13.9**	**1.0**	**2.5**
TOTAL ANNUALS	**0.6**	**20.1**	**1.0**	**4.5**
TOTAL VEGETATIVE COVER	**0.6**	**22.1**	**6.7**	**15.4**
Cobble (8-25 cm)	0.2	0.2	0.2	0.0
Gravel (0.5-8 cm)	26.6	30.1	43.4	61.6
Bare ground	17.7	20.8	13.5	15.3
Straw mulch	15.4	3.6	3.4	0.0
Litter	39.5	23.3	32.8	7.7
TOTAL ABIOTIC	**99.4**	**78.0**	**93.3**	**84.6**

Figure 7-16. Cell 18 Closure Cover showing the abundant saltlover plants (low-growing green plants on the right, no herbicide) and scattered shrubs (left) with no saltlover (herbicide).

(Photo by D.B. Hall, May 29, 2024)

7.8 Cheatgrass Control Research Trial

The Cherrywood Fire burned more than 20,000 ac in the western portion of the NNSS in May 2021. This was the third wildland fire in this area since 2011. One of the major contributing factors to this increased fire frequency is the abundance of cheatgrass, an invasive annual grass. Cheatgrass is problematic for many reasons. It can germinate and grow at colder soil temperatures than many native species so by the time the native species germinate and start growing, the cheatgrass has used up most of the available soil moisture which results in native seedlings struggling to survive. Cheatgrass also has a high germination rate even with little precipitation, grows quickly, and is able to produce a lot of biomass in a short amount of time. Because it is an annual, it dries out early in the season when the soil moisture declines, resulting in an abundant, highly flammable fine fuel that is easily ignited and carries fire readily. It can grow almost anywhere but thrives in areas of disturbance, especially previously burned areas. The cheatgrass biomass is problematic not just for the year in which it germinates but also because the residual biomass can persist for multiple years. The best way to control cheatgrass in the long term is to establish a perennial vegetative community that will outcompete cheatgrass. For short-term control, herbicides such as imazapic (e.g., Panoramic) (1-year control) or indaziflam (e.g., Rejuvra) (3-5 year control) work best. The optimal strategy is to use a combination of herbicide treatments followed by seeding.

NNSS biologists conducted a research trial to evaluate the effectiveness of different herbicide and seeding treatments to control cheatgrass and establish a perennial vegetative community within the Cherrywood Fire burned area. It is anticipated that results will be used to guide future fire rehabilitation efforts and/or proactively protect important areas from burning by reducing the fuel load and creating firebreaks. The

study location is near the East Cat Canyon Road/North Timber Peak spur road (southeast corner of study area at UTM NAD83 555553mE, 4101365mN).

Five treatments were implemented and a control, with three replicates of each in a completely randomized design for a total of 18 plots (Figure 7-17). Treatments included: 1) Rejuvra (liquid Indaziflam) applied by hand at 5.0 ounces/acre (oz/ac) plus 8 oz/ac Efficax (surfactant) plus 25 gallons water/ac, 2) Panoramic (liquid imazapic) applied by hand at 8 oz/ac plus 8 oz/ac Efficax (surfactant) plus 10 gallons water/ac, 3) Open Range G (granular imazapic) applied with hand spreader at 10 pounds (lbs)/ac, 4) seeding a wildland seed mix by hand at a rate of 20 lbs of PLS/ac (Table 7-18) and covering the seed with hand rakes, and 5) seeding the same wildland seed mix as previous by hand at the same rate and not covering the seed. Control plots had no treatment. An additional fire-resistant vegetation treatment (i.e., greenstrip) was implemented in a different but nearby area by hand-seeding a mix of Immigrant forage kochia (*Kochia prostrata*) at a rate of 0.5 lbs PLS/ac and Siberian wheatgrass (*Agropyron fragile*) at a rate of 10 lbs PLS/ac. All plots were 20 m by 20 m (400 m^2 or ~0.1 ac). Plots were staked on November 10, 2021, seeded on November 15, 2021, and herbicide was applied on November 16, 2021.

A follow-up seeding treatment was applied to the herbicide treated and control plots on October 31, 2022, to evaluate if there were residual herbicide effects on seedling germination. The first eight meters of each herbicide-treated and control plot were hand seeded with the same seed mix used before (Table 7-17) at a rate of 14.3 lbs PLS/ac. Seed was then covered using hand rakes.

Plots were sampled in May 2022, May 2023, and May 2024 for plant density (Table 7-19) and percent cover (Table 7-20). Data collected from May 2022 and May 2023 is also included for comparison. Five, 20-m long, permanent transects were established in each plot. Plant density by species was recorded in five, 1-m^2 quadrats on each transect. Due to the high densities of cheatgrass, individual cheatgrass plants were counted only in the upper right quadrant of the 1-m^2 quadrat. Values were multiplied by four and are reported as plants/m^2. Percent cover was also measured with the optical cover scope as described in Section 7.3 and was recorded at nine locations every two meters starting at the 2-m mark, with four points at each location for a total of 36 points per transect. Photographs of each plot were taken during sampling each year.

Very few seedlings of seeded species were recorded in May 2022 and May 2023 so only the herbicide and control plots were sampled in May 2024 and only data from these plots is included in Tables 7-19 and 7-20. This highlights the challenge of establishing a perennial vegetative community in this area. Statistical analysis of the data shows a clear pattern of cheatgrass density and percent cover being lowest in Rejuvra treated plots over the long term. Panoramic and Open Range controlled cheatgrass in the first year and to a lesser degree in the second year but by the third year cheatgrass cover and density in these plots were similar to that in the control plots (Figure 7-18). Density and percent cover of James' galleta (*Pleuraphis jamesii*) were slightly lower in Rejuvra plots than Panoramic, Open Range, and the control plots but plants were more productive and greener with more seedheads in Rejuvra plots. The competitive release from not having to compete for limited soil moisture with cheatgrass apparently benefited this native perennial grass. Desert globemallow also appeared to thrive in Rejuvra plots. Annual forbs appear to be negatively impacted with lower species richness, density, and cover in the Rejuvra plots than in the control plots but still present. It is anticipated that the annual forbs will re-establish over time from the seedbank or from adjacent areas. Results showed Rejuvra had the best multi-year control of cheatgrass which had a positive impact on several perennials and is recommended to be used on a large scale to create firebreaks in cheatgrass dominated areas such as previous burns like the Cherrywood Fire. Plots will continue to be monitored for at least another two years to test the longevity of cheatgrass control for all herbicides. Further analysis will also be conducted to determine herbicide impacts on native annual and perennial plants.

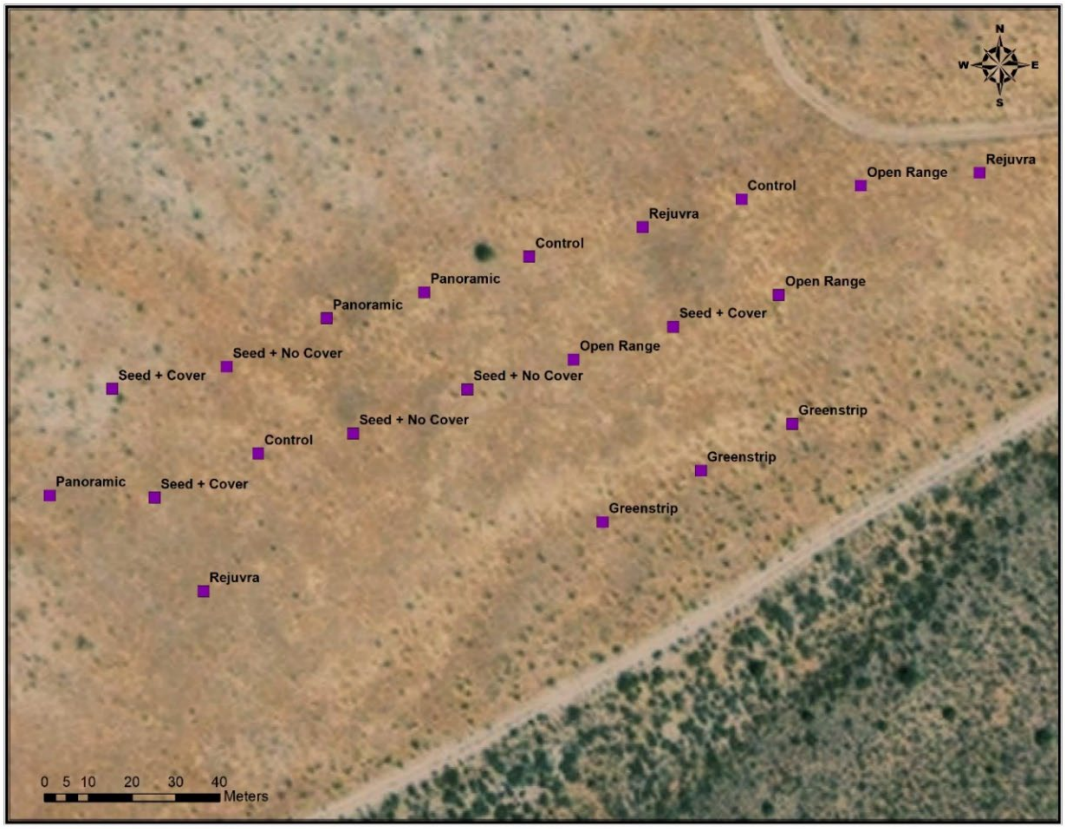

Figure 7-17. Plot layout for cheatgrass control research trial.

Table 7-18. Seed mix used in cheatgrass control research trial.

Lifeform	Species	PLS lbs/acre	PLS seeds/m2
Shrub	*Artemisia nova*	0.2	45
Shrub	*Artemisia tridentata tridentata*	0.1	62
Shrub	*Atriplex canescens*	2.0	27
Shrub	*Chrysothamnus viscidiflorus*	0.2	39
Shrub	*Ephedra nevadensis*	4.6	23
Shrub	*Ephedra viridis*	3.6	22
Shrub	*Ericameria nauseosa leiosperma*	0.2	34
Shrub	*Purshia glandulosa*	4.5	23
Grass	*Achnatherum hymenoides Paloma*	1.1	44
Grass	*Achnatherum speciosa*	1.0	43
Grass	*Elymus elymoides Toe Jam*	1.0	47
Grass	*Poa secunda sandbergii*	0.3	78
Forb	*Linum perenne*	0.5	36
Forb	*Penstemon palmeri Cedar*	0.3	45
Forb	*Sphaeralcea ambigua*	0.4	49
	TOTAL	20.0	617

Table 7-19. Plant density (plants/m^2) by species and lifeform by treatment, May 2022, May 2023, and May 2024.

	Panoramic			Open Range			Rejuvra			Control		
Species/Lifeform	2022	2023	2024	2022	2023	2024	2022	2023	2024	2022	2023	2024
Perennial shrubs	0.03	0.01	0.05	0.00	0.04	0.11	0.08	0.05	0.05	0.05	0.04	0.08
James' galleta	0.91	0.57	0.65	1.28	1.20	0.65	0.63	0.49	0.28	0.88	0.89	0.63
Perennial grasses	NA	NA	0.65	NA	NA	0.71	NA	NA	0.29	NA	NA	0.63
Desert globemallow	0.07	0.05	0.05	0.04	0.04	0.07	0.23	0.27	0.37	0.04	0.56	0.44
Whitemargin sandmat	7.24	5.91	11.61	3.40	4.37	10.47	8.21	5.35	15.28	0.69	15.72	19.40
Lewis flax	NA	NA	0.01	NA	NA	0.11	NA	NA	0.03	NA	NA	0.01
Perennial forbs	7.32	6.01	11.89	3.47	4.47	10.68	8.59	6.03	15.79	0.83	16.31	19.91
Cheatgrass	8.56	33.92	51.41	9.28	61.76	53.60	19.63	8.85	5.01	129.60	152.32	78.99
Bristly fiddleneck	3.93	61.63	3.41	0.44	14.11	2.84	0.69	0.51	0.36	39.91	24.37	1.85
Annual forbs	3.93	69.03	6.00	1.01	16.16	7.51	1.29	0.89	2.09	42.47	27.20	6.71
Species Richness	6.00	13.00	14.00	4.00	13.00	16.00	10.00	11.00	11.00	7.00	14.00	12.00
Ann Forb Species Richness	1.00	10.00	9.00	1.00	5.00	6.00	4.00	3.00	3.00	3.00	7.00	5.00

Table 7-20. Percent plant cover by species and lifeform by treatment, May 2022, May 2023, and May 2024.

	Panoramic			Open Range			Rejuvra			Control		
Species/Lifeform	2022	2023	2024	2022	2023	2024	2022	2023	2024	2022	2023	2024
Perennial Shrubs	0.6	0.8	0.4	1.1	0.6	1.3	0.9	0.6	1.5	1.3	1.1	1.7
James' galleta	1	1.5	5.6	1.1	2.4	5.7	0	1.3	3.3	0.2	1.5	4.8
Perennial grasses	NA	NA	5.6	NA	NA	5.9	NA	NA	3.3	NA	NA	4.8
Cheatgrass	0.6	6.5	27.4	1.3	14.1	30.2	12.2	2.2	7.2	24.8	34.1	39.7
Bristly fiddleneck	0.9	11.3	7.4	0.4	1.7	5.7	0.8	0.4	0.6	3.9	6.3	2.8
Whitemargin sandmat	2.1	1.9	2.6	0.2	0.2	1.9	1.8	0.7	3.1	0.2	3.1	5.0
Desert globemallow	NA	NA	0.0	NA	NA	0.4	NA	NA	4.1	NA	NA	2.8
Perennial forbs	2.1	1.9	5.2	0.2	0.4	2.3	1.8	2.1	7.8	0.2	4.4	8.4
Annual forbs	3	12.1	12.4	0.6	1.7	29.9	3.3	1	7.2	4.3	7.8	10.8
Litter	47.6	14.5	16.6	56.5	20.3	12.2	38.2	16.7	11.7	39.1	18.7	17.2
Total Abiotic	95	77.4	49.1	95.9	80.8	30.5	83.6	92.8	73.0	69.4	51.1	34.8

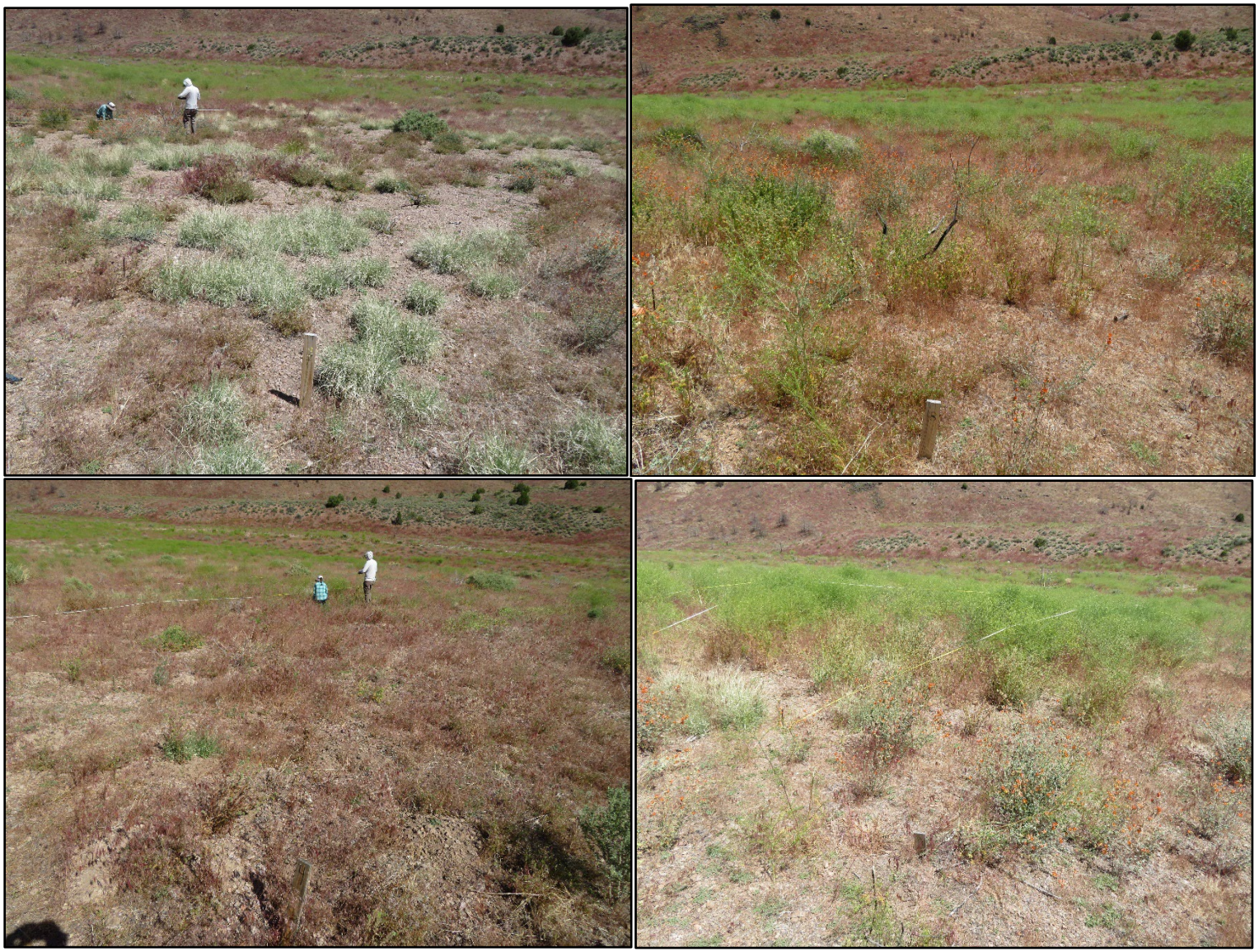

Figure 7-18. Plot comparison (Rejuvra, upper left; control, upper right; Panoramic, lower left; Open Range, lower right).

(Photos by D.B. Hall, May 20-21, 2024)

7.9 Aerial Herbicide Operation Rejuvenation

Thousands of acres on the NNSS have been converted to annual grasslands dominated by cheatgrass and red brome, primarily from wildland fires. These areas are at high risk of burning again due to the abundant, flammable fine fuel the annual grasses create, especially during years of normal or above-normal precipitation. Fire suppression activities are expensive and somewhat limited in these areas for many reasons, including inaccessibility (e.g., rugged terrain, remoteness), presence of unexploded ordnance, and radiological concerns. Prevention is the best way to minimize the spread and negative impacts of wildland fire. A useful technique is to strategically create wide firebreaks in these annual grasslands to prevent fire spread if a fire is ignited. Usually, firebreaks are made with heavy equipment (e.g., road grader, bulldozer) but this is cost-prohibitive and impractical in many rugged areas. Aerial application of herbicides to create firebreaks on a large scale is a novel approach worth investigating.

A collaborative effort (Operation Rejuvenation) between NNSS and Nellis Air Force Base biologists was planned and implemented in 2023 to treat large areas with the pre-emergent herbicide, Rejuvra, to create firebreaks in annual grasslands on the NNSS and NTTR. The plane can spray a 100-foot-wide swath with each pass, and it was determined that two parallel passes would create a sufficient firebreak with a combined width of 200 feet per firebreak. Based on results from the Cheatgrass Control Research Trial, aerial application was a technique worth evaluating. The Ohio Air Reserve Unit is a U.S. Air Force program that has unique capabilities utilizing a C-130 transport plane and high-capacity spray system to carry out missions world-wide such as spraying to control mosquitoes after hurricanes, spraying for invasive plant species, and other military missions. To keep their crew trained and equipment functional they need to conduct training missions. We were able to utilize this asset, only covering the cost for the herbicide and the crew's per diem, resulting in huge cost savings.

7.9.1 Operation Rejuvenation 2023

In early November 2023, firebreaks on the NNSS were strategically placed in Mid Valley and the Timber Mountain/Buckboard Mesa area and 1,884 ac were treated during 6.7 hours of flight time. Current aerial imagery was used to maximize the placement of firebreaks in annual grass dominated areas. The spray mix included Rejuvra at 5 oz/ac, Grounded (surfactant/adjuvant) at 8 oz/ac, spray dye at 8 oz/ac, and water at 7 gallons/ac. An additional 2,334 ac were sprayed on NTTR.

Research plots (10-m x 10-m) on the NNSS were established to determine the efficacy of the treatment. Control plots were covered with plastic sheeting during spraying operations to prevent herbicide from hitting the ground while treated plots were left uncovered. Plastic sheeting was deployed a few days before spraying and removed within a day or two after spraying. Spray dye was used to verify the spray pattern and coverage. The green colorant dissipates after about 72 hours and is not visible after that. Paired treated and control plots replicated three times at each site were established in Mid Valley (UTM NAD83 573023mE, 4090457mN), near Buggy crater (UTM NAD83 554416mE, 4096985mN), and on the North Timber Mountain spur road (UTM NAD83 554132mE, 4102731mN). These plots were sampled for plant density (Table 7-21) in 12, 1-m^2 quadrats per plot and percent cover (Table 7-22) at 48 points per plot by species in May 2024 to evaluate the effectiveness of this technique on controlling cheatgrass and its impacts on other species.

Cheatgrass density was much lower in plots treated with Rejuvra compared to the control at Mid Valley and Buggy (Figure 7-19) study sites but comparable to each other at the North Spur Road site (Table 7-21). Percent cheatgrass cover in Rejuvra plots was less than half that found in the control at the

Table 7-21. Plant density (plants/m^2) for three study plots by species and lifeform for Rejuvra-treated and control plots, May 2024.

	Mid Valley		Buggy		North Spur Road	
Species/Lifeform	Rejuvra	Control	Rejuvra	Control	Rejuvra	Control
Cheatgrass	57.78	155.56	53.75	124.55	179.55	210.78
Red brome	0.06	0.00	0.00	0.00	0.00	0.00
Annual Grasses	**57.84**	**155.56**	**53.75**	**124.55**	**179.55**	**210.78**
Rubber rabbitbrush	0.00	0.11	0.00	0.00	0.00	0.00
Yellow rabbitbrush	0.00	0.00	0.00	0.03	0.00	0.00
Blackbrush	0.00	0.03	0.00	0.00	0.00	0.00
Desert bitterbrush	0.00	0.00	0.06	0.03	0.03	0.00
Mormon tea	0.00	0.00	0.22	0.06	0.00	0.00
Virgin River brittlebush	0.00	0.00	0.00	0.03	0.08	3.31
Shrubs	**0.00**	**0.14**	**0.28**	**0.15**	**0.11**	**3.31**
Indian ricegrass	0.00	0.03	0.00	0.00	0.00	0.00
Desert needlegrass	0.03	0.31	0.00	0.00	0.00	0.00
Squirreltail	0.00	0.00	0.03	0.00	0.14	0.06
James' galleta	0.00	0.00	0.00	0.00	1.53	0.11
Sandberg bluegrass	0.00	0.00	0.00	0.00	0.28	0.00
Perennial Grasses	**0.03**	**0.34**	**0.03**	**0.00**	**1.95**	**0.17**
Wiggins' cholla	0.03	0.00	0.00	0.00	0.00	0.00
Desert globemallow	3.97	2.64	4.31	3.72	0.78	0.94
Cold-desert phlox	0.08	1.83	0.00	0.36	0.17	0.22
Freckled milkvetch	0.31	0.44	0.00	0.00	0.00	0.00
Engelmann's hedgehog cactus	0.00	0.00	0.00	0.00	0.03	0.00
Matted buckwheat	0.00	0.00	0.00	0.00	0.06	0.00
Perennial Forbs/Cactus	**4.39**	**4.91**	**4.31**	**4.08**	**1.04**	**1.16**
Redstem stork's bill	56.33	51.78	18.03	14.47	0.28	0.33
Birdnest buckwheat	0.00	0.33	0.03	0.19	1.17	0.31
Western tansymustard	1.86	0.75	0.00	0.00	2.78	0.86
Pacific blazingstar	0.00	0.08	0.00	0.00	0.00	0.00
Tall tumblemustard	0.06	0.08	0.00	0.00	0.00	0.00
Hoary tansyaster	0.08	0.00	0.03	0.00	0.00	0.00
Bristly fiddleneck	0.06	0.00	0.19	0.39	0.67	0.86
Esteve's pincushion	0.00	0.00	0.03	0.00	0.00	0.00
Great Basin woollystar	0.00	0.00	0.00	0.17	0.00	0.00
Gilia species	0.00	0.00	0.00	0.31	0.00	0.00
Desert indianwheat	0.00	0.00	0.00	0.00	2.22	0.00
Moth combseed	0.00	0.00	0.00	0.00	0.64	0.00
Fineleaf hymenopappus	0.00	0.00	0.00	0.00	1.14	0.00
New Mexico thistle	0.00	0.00	0.00	0.00	0.03	0.00
Astragalus species	0.00	0.00	0.00	0.00	0.00	0.08
Annual Forbs	**58.39**	**53.02**	**18.31**	**15.53**	**8.93**	**2.44**

Table 7-22. Percent plant cover for three study plots by species and lifeform for Rejuvra-treated and control plots, May 2024.

	Mid Valley		Buggy		North Spur Road	
Species/Category	Treatment	Control	Treatment	Control	Treatment	Control
Cheatgrass	10.4	9.7	23.6	54.2	51.4	51.4
Red brome	0.7	0.0	0.0	0.0	0.0	0.0
Annual Grasses	**11.1**	**9.7**	**23.6**	**54.2**	**51.4**	**51.4**
Rubber rabbitbrush	0.7	2.1	0.0	0.0	0.0	0.0
Blackbrush	0.0	0.7	0.0	0.0	0.0	0.0
Desert bitterbrush	0.0	0.0	1.4	0.7	1.4	4.2
Mormon tea	0.0	0.0	3.5	4.9	0.7	0.7
Fourwing saltbush	0.0	0.0	0.7	0.0	0.0	0.0
Virgin River brittlebush	0.0	0.0	0.0	0.0	0.0	0.7
Shrubs	**0.7**	**2.8**	**5.6**	**5.6**	**2.1**	**5.6**
Desert needlegrass	0.0	2.1	0.0	0.0	0.0	0.0
James' galleta	0.0	0.0	0.0	0.0	7.6	0.7
Squirreltail	0.0	0.0	0.0	0.0	0.7	0.7
Perennial Grasses	**0.0**	**2.1**	**0.0**	**0.0**	**8.3**	**1.4**
Desert globemallow	6.3	2.8	21.5	13.2	0.0	1.4
Cold-desert phlox	0.0	0.0	0.0	0.0	0.0	0.7
Matted buckwheat	0.0	0.0	0.0	0.0	0.7	0.0
Wiggins' cholla	0.7	0.0	0.0	0.0	0.0	0.0
Perennial Forbs/Cactus	**7.0**	**2.8**	**21.5**	**13.2**	**0.7**	**2.1**
Redstem stork's bill	10.4	3.5	3.5	2.1	0.0	0.0
Western tansymustard	0.0	0.0	0.0	0.0	0.7	2.1
Bristly fiddleneck	0.0	0.0	0.0	0.0	0.0	1.4
Annual Forbs	**10.4**	**3.5**	**3.5**	**2.1**	**0.7**	**3.5**
Litter	60.5	70.1	17.4	8.3	16.7	18.8
Bare ground	0.7	0.7	0.0	0.0	2.1	2.1
Gravel	9.7	8.3	27.8	16.0	9.7	9.0
Cobble	0.0	0.0	0.7	0.0	0.0	0.0
Rock	0.0	0.0	0.0	0.7	8.3	6.3
Abiotic	**70.9**	**79.1**	**45.9**	**25.0**	**36.8**	**36.2**

Buggy site and nearly equal at Mid Valley and North Spur Road sites. There were fewer cheatgrass plants at Mid Valley, but they were bigger than at the other sites. Other annual and perennial species did not seem to be negatively impacted by Rejuvra, and the important perennial forb desert globemallow responded favorably. Cheatgrass control was not as good as expected which may be because cheatgrass had already germinated from heavy rainfall in August and September and Rejuvra is strictly a pre-emergent with no impact to already growing plants. Sampling in 2025 will help answer if this was the cause. Another reason may be due to windy conditions on the day we sprayed and rugged topography that did not allow the C-130 to fly low enough for good dispersal. In fact, this was the case when we sprayed the North Spur Road area. Based on the spray pattern determined from the spray dye, application was very light with very fine drops at this site.

Figure 7-19. Reduced cheatgrass density and cover in Rejuvra treated plot (upper) compared to a control plot (lower).

(Photo by D.B. Hall, May 15, 2024.)

7.9.2 Operation Rejuvenation 2024

In November 2024, several additional 200-foot-wide firebreaks covering approximately 1,690 ac were created in Mid Valley, Area 16 Fire burn, Orange Blossom Road, and the Ribbon Cliff Wildland Fire burn (Figure 7-20) with the C-130 (Figure 7-21). We modified our methods based on lessons learned from 2023. We included imazapic herbicide (all areas but recent Ribbon Cliff Wildland Fire burn) which is both a short-term (one year) pre-emergent and post-emergent, increased the amount of water used from seven to nine gallons per acre for better distribution, and placed firebreaks in lower-relief topography. Like 2023, paired treated and control plots were established in Mid Valley, Orange Blossom Road, and Ribbon Cliff Fire burn to evaluate the efficacy of this technique on controlling cheatgrass. These plots will be monitored for plant density and cover by species over the next several years to evaluate its efficacy to control cheatgrass and impacts to other species.

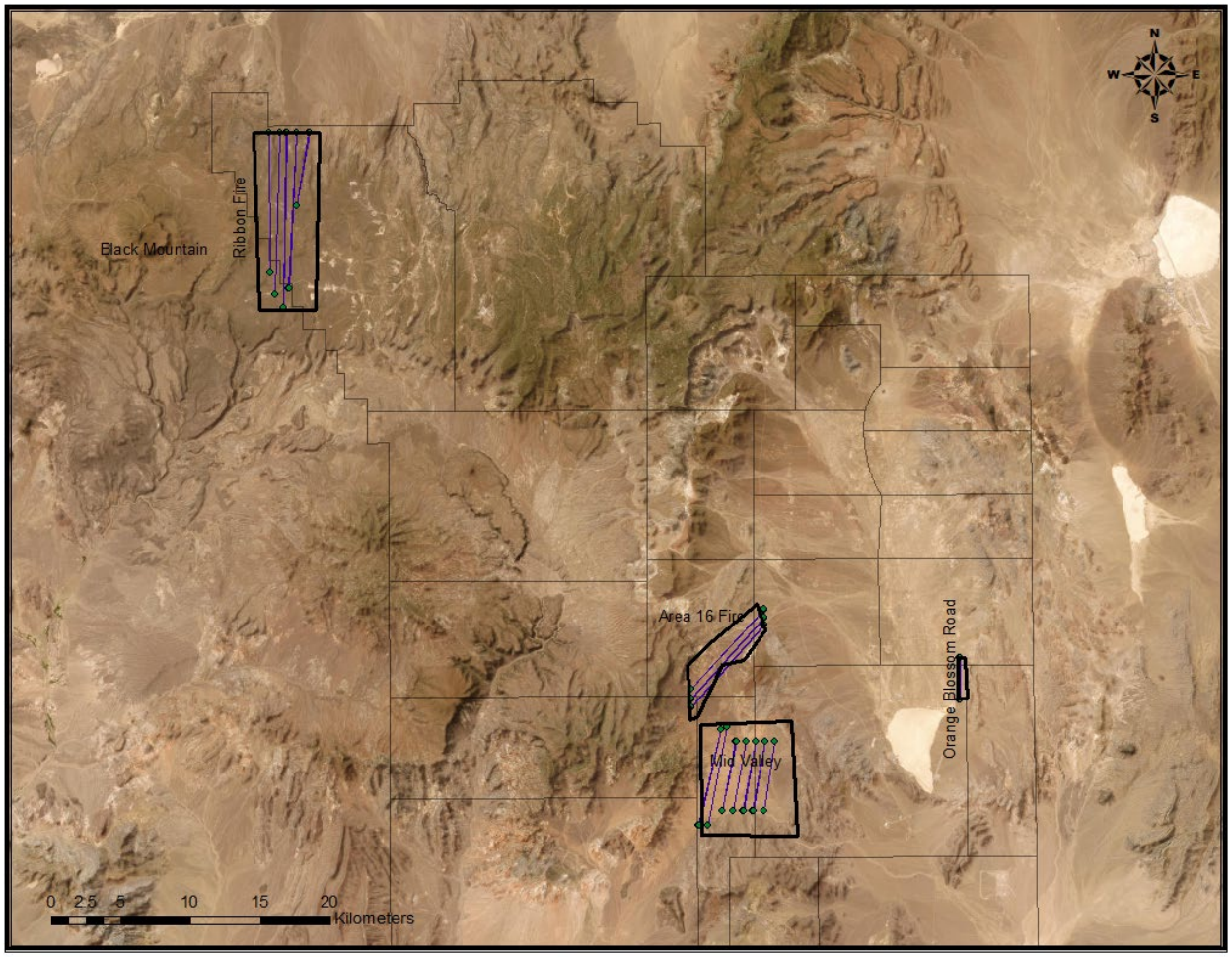

Figure 7-20. Map of firebreaks (purple lines, green dots are starting and ending points) on the NNSS created by aerially applying herbicide, November 2024.

Figure 7-21. Aerial application of Rejuvra using the C-130 in the Ribbon Cliff Wildland burn area.

(Photo by D.B. Hall, November 9, 2024)

7.10 Area 16 Burn Seeding Project

In July 2020, the Area 16 Fire burned approximately 3,131 ac in predominantly blackbrush habitat between Tippipah Highway and Mid Valley Road. To establish a native perennial vegetation community to outcompete cheatgrass and reduce the risk of a wildland fire destroying power infrastructure, approximately 11 ac were seeded adjacent to an active powerline in December 2023. It is too expensive to revegetate the entire burned area, and therefore seeding locations were strategically selected to protect important infrastructure and habitat. The site was prepared by dragging a heavy chain harrow across the area to be seeded using a utility task vehicle (UTV). This technique loosens the surface, which facilitates seed coverage and promotes germination. Following harrowing, seed was broadcast on the surface using a drill seeder pulled behind the UTV. A light chain harrow dragged behind the seeder covered the seed. The seedmix was composed of nine shrub, three perennial grass, and three perennial forb species, seeded at a rate of 20 pounds of pure live seed per acre. The seeded area and a nonseeded control area were monitored in 2024 to evaluate success. An average of around 5.0 seeded seedlings/m^2 were found with most of them being Lewis Flax (*Linum perenne*) at 3.3 seedlings/m^2.

7.11 Coordination with Habitat Restoration Practitioners

NNSS biologists interfaced with other habitat restoration practitioners in 2024 for the following activities:

- By request, hosted a tour of successfully revegetated sites on the NNSS for several BLM biologists in April.
- By request, hosted a tour of successfully revegetated cover caps at Area 5 RWMC for several Nevada Department of Transportation biologists in December.
- Attended and gave a presentation on the NNSS Cheatgrass Mitigation Program at the Nevada Chapter of The Wildlife Society's annual meeting in Reno.

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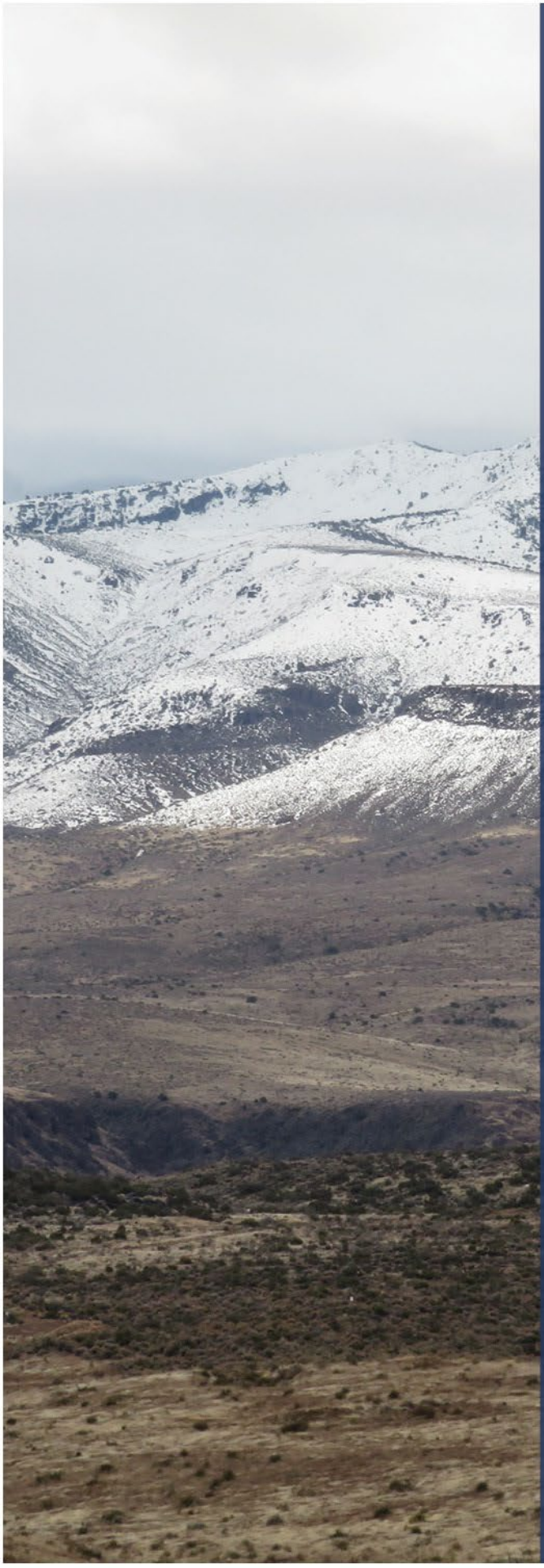

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