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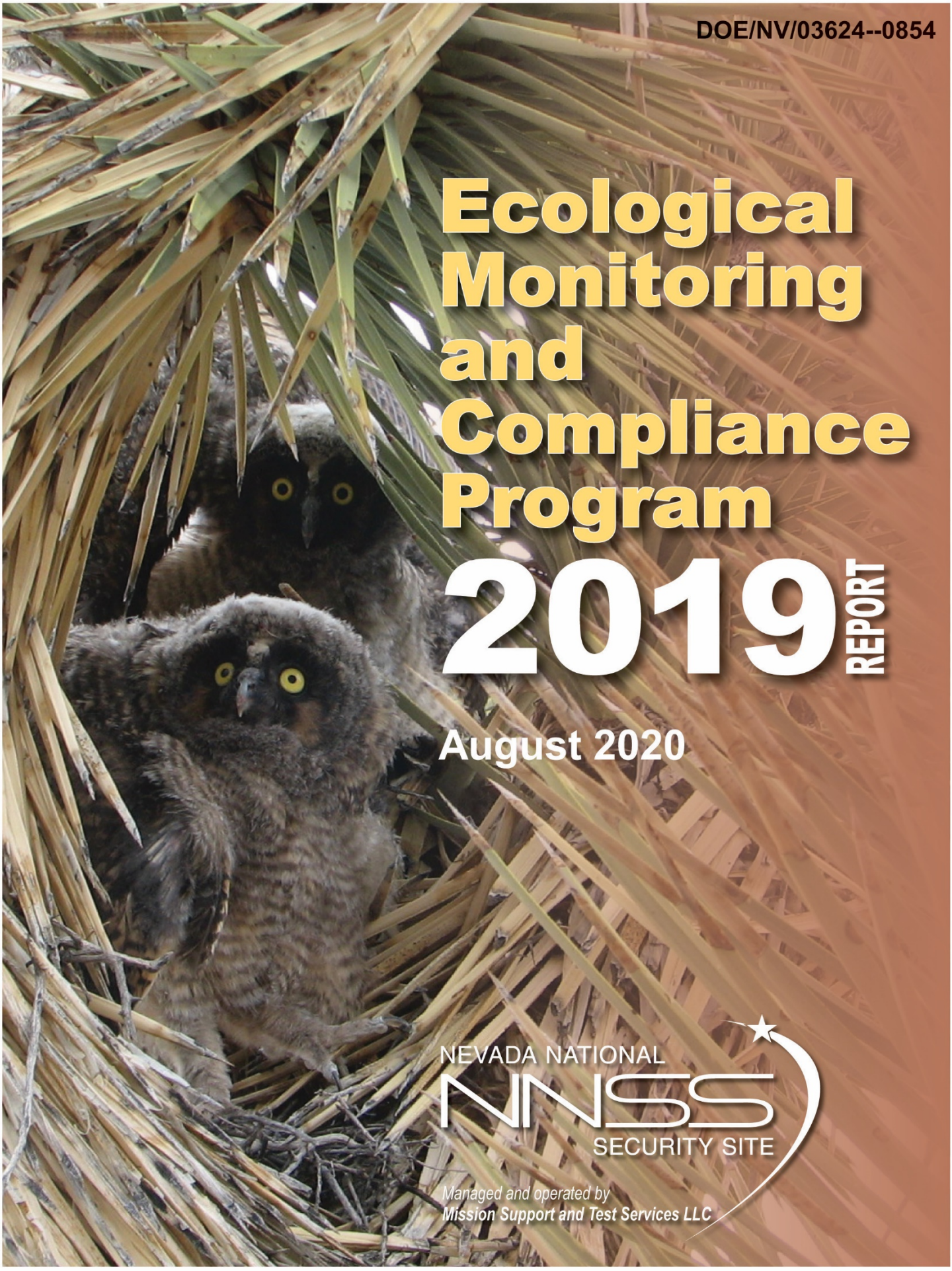

Ecological Monitoring and Compliance Program 2019 REPORT

August 2020

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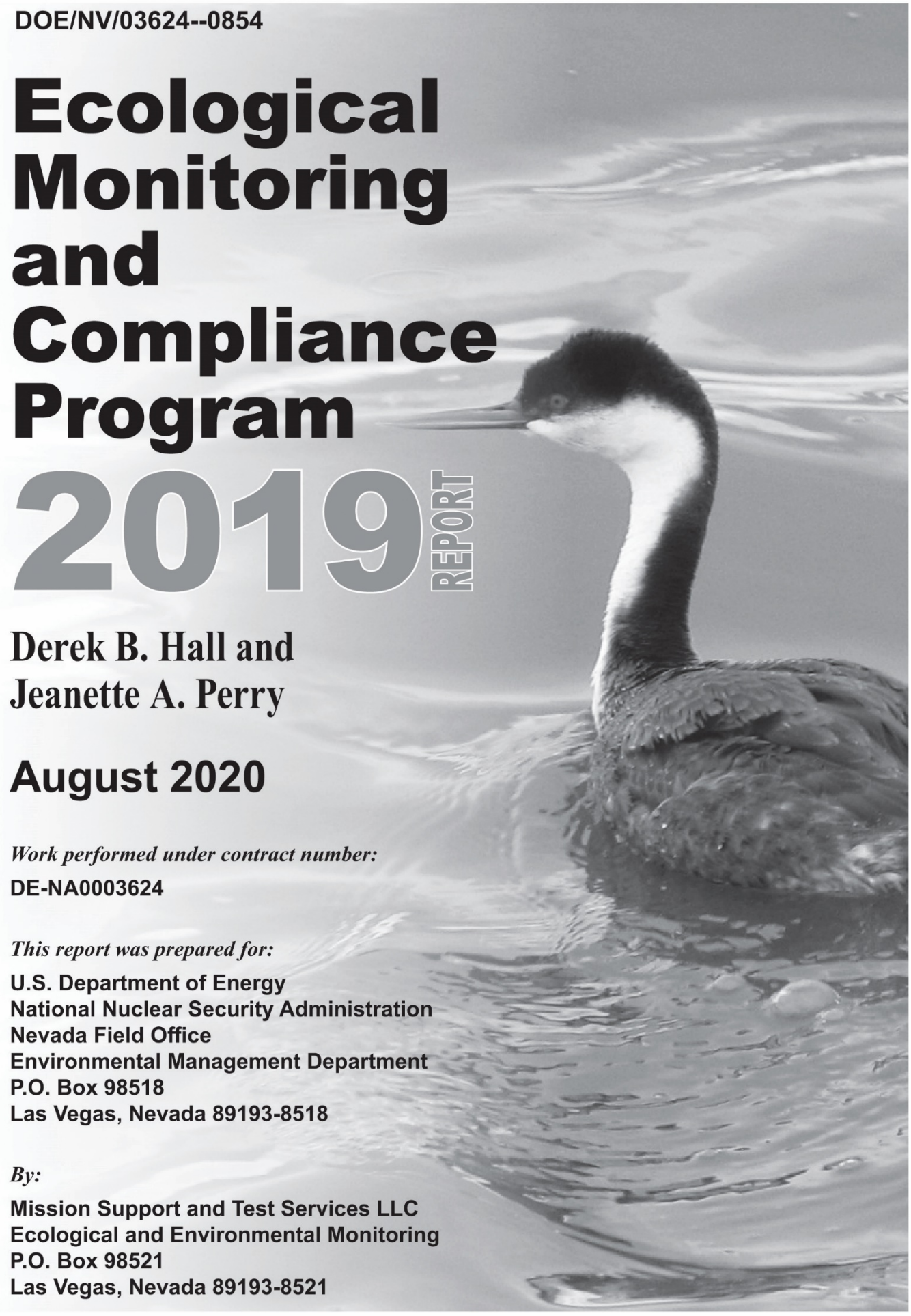

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EXECUTIVE SUMMARY

The Ecological Monitoring and Compliance Program (EMAC), funded through the U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office (NNSA/NFO), monitors the ecosystem 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 2019. 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 monitoring. During 2019, all applicable laws, regulations, and permit requirements were met, enabling EMAC to achieve its intended goals and objectives.

Sensitive and protected/regulated species of the NNSS include 42 plants, 1 mollusk, 2 reptiles, 241 birds, and 23 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 33 projects. A total of 141.2 hectares (ha) were surveyed for these projects. The surveyed area included the project area and a buffer area extending 10-20 meters (m) beyond the project area. Some of the sensitive and protected/regulated species and important biological resources found during the surveys included bird nesting sites; western red-tailed skink (*Plestiodon gilberti rubricaudatus*) habitat; predator burrows utilized by desert tortoises; bat sign within abandoned buildings; ungulate sign (pronghorn antelope [*Antilocapra americana*], feral burro [*Equus asinus*], feral horse [*Equus caballus*] and mule deer [*Odocoileus hemionus*]); two sensitive plant species (Cane Spring Suncup [*Camissonia megalantha*] and sand cholla [*Grusonia pulchella*]); yucca plants (Joshua tree [*Yucca brevifolia*] and Mojave yucca [*Yucca schidigera*]); singleleaf pinyon (*Pinus monophylla*); and multiple cactus species. Scientists communicated with ground crews and provided written summary reports to project managers of survey findings and mitigation recommendations when applicable.

Twenty-one surveys were completed by biologists within the range of the desert tortoise in 2019. No desert tortoises were observed or reported injured or killed during projects and no desert tortoise habitat was disturbed. All projects that were monitored within tortoise habitat remained within the surveyed project area.

There were 66 reported desert tortoise roadside sightings during 2019. Fifty-four of the encountered tortoises were determined to be in harm's way and moved off the road in accordance with FWS-approved tortoise handling procedures. Amongst the 54 tortoises moved off NNSS roads, one was a juvenile tortoise found with active bird predation wounds on the carapace. The tortoise was alive, taken to a veterinarian and later euthanized for its life-threatening injuries. Two of the roadside sightings were roadkills. One was a juvenile found on a dirt road in Area 5 and the other was an adult found on Jackass Flats Road in Area 22.

Juvenile tortoises continued to be monitored as part of a collaborative effort to study survival of translocated animals. After 88 months post-release, 23 of the 60 juveniles were still alive (38.3% survival) which is somewhat higher but similar to an estimated 33% survival in a natural population. There is a much higher survival rate for males (50% [15 of 30]) compared to females (28% [8 of 29]) with most of the mortalities suspected as coyote and kit fox predation.

From 1978 to 2019, there has been an average of 10.3 wildland fires per year on the NNSS with an average of about 98.0 ha burned per fire. Two wildland fires were reported on the NNSS in 2019, both of

which were very small (0.1 acres). They were extinguished by NNSS Fire and Rescue personnel or carefully monitored until they burned out.

Wildlife use at nine natural water sources (one well pond, five water troughs, and three radiologically contaminated sumps) was documented using motion-activated cameras. Field surveys for sensitive plants were conducted for black woollypod (*Astragalus funereus*), Cane Spring suncup, Pahute green gentian (*Frasera pahutensis*), sanicle biscuitroot (*Cymopterus ripleyi* var. *saniculoides*), weasel phacelia (*Phacelia mustelina*), and rock purpusia (*Ivesia arizonica* var. *saxosa*).

Surveys of sensitive and protected/regulated animals in 2019 focused on birds, bats, feral horses, mule deer, pronghorn antelope, desert bighorn sheep (*Ovis canadensis nelsoni*), and mountain lions (*Puma concolor*). Additional information is presented about bird mortalities, *Migratory Bird Treaty Act* compliance, nuisance animals and their control, and increasing populations of feral burros.

A total of 19 dead birds were documented on the NNSS in 2019. Fourteen (4 red-tailed hawks [*Buteo jamaicensis*] and 10 common ravens [*Corvus corax*]) were electrocuted, one red-tailed hawk was found severely injured due to unknown causes and was euthanized, one northern harrier (*Circus cyaneus*) was injured due to unknown causes and died the next day, and three European starlings (*Sturnus vulgaris*) were found dead due to entrapment. No golden eagle (*Aquila chrysaetos*) deaths were documented. A total of 157 poles were retrofitted or reconfigured during 2019. A variety of retrofits were made including installing insulator covers and extenders, perch deterrents, conductor wire covers, and fuse covers. Three golden eagle sightings were documented during the winter raptor surveys. This is quite a few less than last year's total of 11 golden eagle sightings across all surveys. The red-tailed hawk was the most common species detected on both survey routes, comprising nearly two-thirds of all raptor sightings. Common ravens were more prevalent on the southern route this year than in Yucca Flat with most of them observed near the Mercury Sewage Lagoons.

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. A total of 57 individuals were identified in at least seven different bands with at least six foals and nine juveniles observed. A total of 119 deer were observed during spotlight surveys, which equates to an average of 19.8 deer per survey night. Thirteen marked sheep were documented with camera traps at water sources in the Shoshone Mountain, Yucca Mountain, Fortymile Canyon areas. These included eight ewes (six captured in 2016 and two captured in 2015) and five rams (four captured in 2016 and one captured in 2015). In addition to the 13 marked sheep, a minimum of 11 unmarked sheep (four adult ewes, one young ewe, two lambs, three adult rams, and one young ram) were also detected at the monitored water sources. Combined, a minimum of 24 sheep were documented at monitored water sources on the NNSS in 2019.

A total of 69 mountain lion images (i.e., photographs or video clips) were taken during 112,428 camera hours at 7 of 25 sites sampled. An additional 20,175 images of at least 52 species other than mountain lions were also documented. This is the greatest species richness documented using camera traps in a given year and the highest number of images per 1000 camera hours by more than three-fold. A minimum of five individual mountain lions (adult male and adult female with three subadults) were known to occur on the NNSS in 2019.

Habitat restoration activities conducted in 2019 included visually assessing the vegetation at the U-3ax/bl closure cover (CAU 110) and the "92-Acre Site" (CAU 111), overseeing and supporting the revegetation of Clean Slate II and Clean Slate III sites on the Tonopah Test Range, and preparing for the revegetation of Cell 18 at the Area 5 Radioactive Waste Management Complex.

TABLE OF CONTENTS

Page

TABLE OF CONTENTS (continued)

Page

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

α	statistical significance level
ac	acre(s)
APP	Avian Protection Plan
BCS	Body Condition Score
BRSV	Bovine Respiratory Syncytial Virus
CAU	Corrective Action Unit
cm	centimeter(s)
DTM	Desert Tortoise Monitor
DOE	U.S. Department of Energy
DOE/NV	U.S. Department of Energy, Nevada Operations Office
EGIS	Ecological Geographic Information System
EHD	Epizootic Hemorrhagic Disease
ELU	Ecological Landform Unit
EMAC	Ecological Monitoring and Compliance Program
EO	Executive Order
ESA	Endangered Species Act
FWS	U.S. Fish and Wildlife Service
g	gram(s)
GPS	Global Positioning System
ha	hectare(s)
ICR	San Diego Zoo Institute for Conservation Research
km	kilometer(s)
LANL	Los Alamos National Laboratory
m	meter(s)
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
NAC	Nevada Administrative Code
NAD	North American Datum

NDOW	Nevada Department of Wildlife
NNHP	Nevada Natural Heritage Program
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
p	probability
pCi/L	picocuries per liter
PI-3	Parainfluenza Virus
r	correlation coefficient
RWMC	Radioactive Waste Management Complex
sd	standard deviation
spp.	species
TCS	tortoise clearance survey
TLD	thermoluminescent dosimeter
UGTA	Underground Test Area
USACE	U.S. Army Corps of Engineers
USDA	United States Department of Agriculture
USDA-APHIS-NWRC	United States Department of Agriculture, Animal and Plant Health Inspection Service, National Wildlife Research Center
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
var.	variety

1.0 INTRODUCTION

In accordance with 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 U.S. Department of Energy, 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 2019, all applicable laws and regulations were followed, and the permit requirements were met, enabling EMAC to achieve its intended goals and objectives.

This report summarizes the EMAC activities conducted by MSTS during calendar year 2019. For purposes of this report, MSTS will be referred to when discussing work accomplished by NNSS biologists. Monitoring tasks during 2019 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 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 are within the project area 2) a biological survey is required to identify sensitive and protected/regulated species within the project area and/or 3) developing mitigation measures to protect impacted species is required. Projects submit their 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 with 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 are defined as species that are at risk of extinction or serious decline or whose long-term viability has been identified as a concern. They include species on the Nevada Natural Heritage Program (NNHP) At-Risk Plant and Animal Tracking List (NNHP 2020). 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 cover sites, nest or burrow sites, roost sites, or water sources important to sensitive species. Survey reports document species and resources found and provide mitigation recommendations.

2.1 SITES SURVEYED AND SENSITIVE AND PROTECTED/REGULATED SPECIES OBSERVED

In 2019, biological surveys were conducted for 33 projects on the NNSS (Figure 2-1 and Table 2-2). Scientists surveyed a total of 141.2 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. Twenty-one projects were within the range of the threatened desert tortoise (*Gopherus agassizii*) (see Section 3.0). Although within the range of the desert, several of these projects did not have the potential to disturb tortoise habitat. Three projects were within the Frenchman Flat desert tortoise exclusion zone (an area identified as having very low tortoise presence), five projects were within buildings and five other projects were in disturbed areas. Sensitive and protected/regulated wildlife species and important biological resources found during the surveys included bird nesting sites; western red-tailed skink habitat (*Plestiodon gilberti rubricaudatus*); predator burrows utilized by desert tortoises; bat sign within abandoned buildings; ungulate sign (pronghorn antelope [*Antilocapra americana*], feral burro [*Equus asinus*], feral horse [*Equus caballus*] and mule deer [*Odocoileus hemionus*]); two sensitive plant species (Cane Spring Suncup [*Camissonia megalantha*] and sand cholla [*Grusonia pulchella*]); yucca plants (Joshua tree [*Yucca brevifolia*] and Mojave yucca [*Yucca schidigera*]); singleleaf pinyon (*Pinus monophylla*); and multiple cactus species (see Table 2-2 for resources listed by project). Scientists communicated with ground crews and provided written summary reports to project managers of survey findings and mitigation recommendations when applicable (Table 2-2).

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, desert tortoises may move through project areas and may be concealed under vegetation during activities where heavy equipment is used, and western burrowing owls (*Athene cunicularia hypugaea*) frequently inhabit burrows, buried

Table 2-1. List of sensitive and protected/regulated species known to occur on or adjacent to 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 nyensis	Nye milkvetch	S, E
Astragalus oophorus var. *clokeyanus*	Clokey eggvetch	S, W
Chylismia megalantha	Cane Spring suncup	S, M
Cymopterus ripleyi var. *saniculoides*	Sanicle biscuitroot	S, M
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
Grusonia pulchella	Sand cholla	S, CY, E
Hulsea vestita ssp. *inyoensis*	Inyo hulsea	S, W
Ivesia arizonica var. *saxosa*	Rock purpusia	S, H
Penstemon fruticiformis ssp. *amargosae*	Death Valley beardtongue	S, H
Penstemon pahutensis	Pahute Mesa beardtongue	S, W
Phacelia beatleyae	Beatley scorpionflower	S, M
Phacelia filiae	Clarke phacelia	S, M
Phacelia mustelina	Weasel phacelia	S, Ma
Sclerocactus polyancistrus	Redspined fishhook cactus	S, CY, Ma
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 or adjacent to the NNSS (continued).

Animal Species	Common Name	Status[a]
Mollusk Species		
Pyrgulopsis turbatrix	Southeast Nevada pyrg	S, A
Reptile Species		
Plestiodon gilberti rubricaudatus	Western red-tailed skink	S, IA
Gopherus agassizii	Desert tortoise	LT, S, NPT, A
Bird Species[b]		
Accipiter gentilis	Northern goshawk	S, NPS, A
Alectoris chukar	Chukar	G, IA
Aquila chrysaetos	Golden eagle	EA, NP, A
Asio flammeus	Short-eared owl	S, A
Asio otus	Long-eared owl	S, A
Callipepla gambelii	Gambel's quail	G, IA
Coccyzus americanus	Western yellow-billed cuckoo	LT, S, NPS, IA
Corvus brachyrhynchos	American crow	G, IA
Falco peregrinus	Peregrine falcon	S, NPE, A
Gymnorhinus cyanocephalus	Pinyon jay	S, NP, IA
Haliaeetus leucocephalus	Bald eagle	EA, S, NPE, A
Ixobrychus exillis hesperis	Western least bittern	S, NP, IA
Lanius ludovicianus	Loggerhead shrike	NPS, A
Melanerpes lewis	Lewis woodpecker	S, IA
Oreoscoptes montanus	Sage thrasher	NPS, IA
Riparia riparia	Bank swallow	S, IA
Spinus pinus	Pine siskin	S, IA
Spizella breweri	Brewer's sparrow	NPS, IA
Toxostoma lecontei	LeConte's thrasher	S, NP, IA
Mammal Species		
Antilocapra americana	Pronghorn antelope	G, A
Antrozous pallidus	Pallid bat	NP, A
Cervus elaphus	Rocky Mountain elk	G, IA
Corynorhinus townsendii	Townsend's big-eared bat	S, NPS, A

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

Animal Species	Common Name	Status[a]
Equus asinus	Burro	H&B, A
Equus caballus	Horse	H&B, A
Euderma maculatum	Spotted bat	S, NPT, A
Lasionycteris noctivagans	Silver-haired bat	S, A
Lasiurus blossevillii	Western red bat	S, NPS, A
Lasiurus cinereus	Hoary bat	S, A
Lynx rufus	Bobcat	F, IA
Microdipodops megacephalus	Dark kangaroo mouse	NP, A
Microdipodops pallidus	Pale kangaroo mouse	S, NP, A
Myotis thysanodes	Fringed myotis	S, NP, A
Ovis canadensis nelson	Desert bighorn sheep	G, A
Odocoileus hemionus	Mule deer	G, A
Puma concolor	Mountain lion	G, A
Sorex tenellus	Inyo shrew	S, IA
Sylvilagus audubonii	Audubon's cottontail	G, IA
Sylvilagus nuttallii	Nuttall's cottontail	G, IA
Tadarida brasiliensis	Brazilian free-tailed bat	NP, A
Urocyon cinereoargenteus	Gray fox	F, IA
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 Natural Heritage Program – At-Risk Plant and Animal Tracking List
NPE	Nevada Protected-Endangered, species protected under Nevada Administrative Code (NAC) 503
NPT	Nevada Protected-Threatened, species protected under 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

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

F	Regulated as fur bearer species under NAC 503
State of Nevada – Plants	
S	Nevada Natural Heritage Program (NNHP) – At-Risk Plant and Animal Tracking List
CY	Protected as a cactus, yucca, or Christmas tree from unauthorized collection on public lands
NNSS Sensitive Plant Ranking	
E	Evaluate
H	High
M	Moderate
W	Watch
Ma	Marginal
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, Gambel's quail, 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 NAC503.

Sources used: NNHP 2020, Nevada Native Plant Society (NNPS) 2019, NAC 2020, U.S. Fish and Wildlife Service (FWS) 2020

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.

During vegetation mapping surveys of the NNSS, delineated areas of homogeneous plant and wildlife 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) (U.S. Department of Energy, Nevada Operations Office [DOE/NV] 1998).

Project 18-07 disturbed 1.02 ha of *Sensitive Habitat* and project 18-66 disturbed 2.26 ha of habitat considered *Unique* and *Sensitive*. The total area disturbed (ha) of important habitat types tracked since 1999 comprises 9.46 (*Pristine*), 19.72 (*Unique*), 382.79 (*Sensitive*), and 87.05 (*Diverse*). Projects in 2019 disturbed a total of 8.98 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.

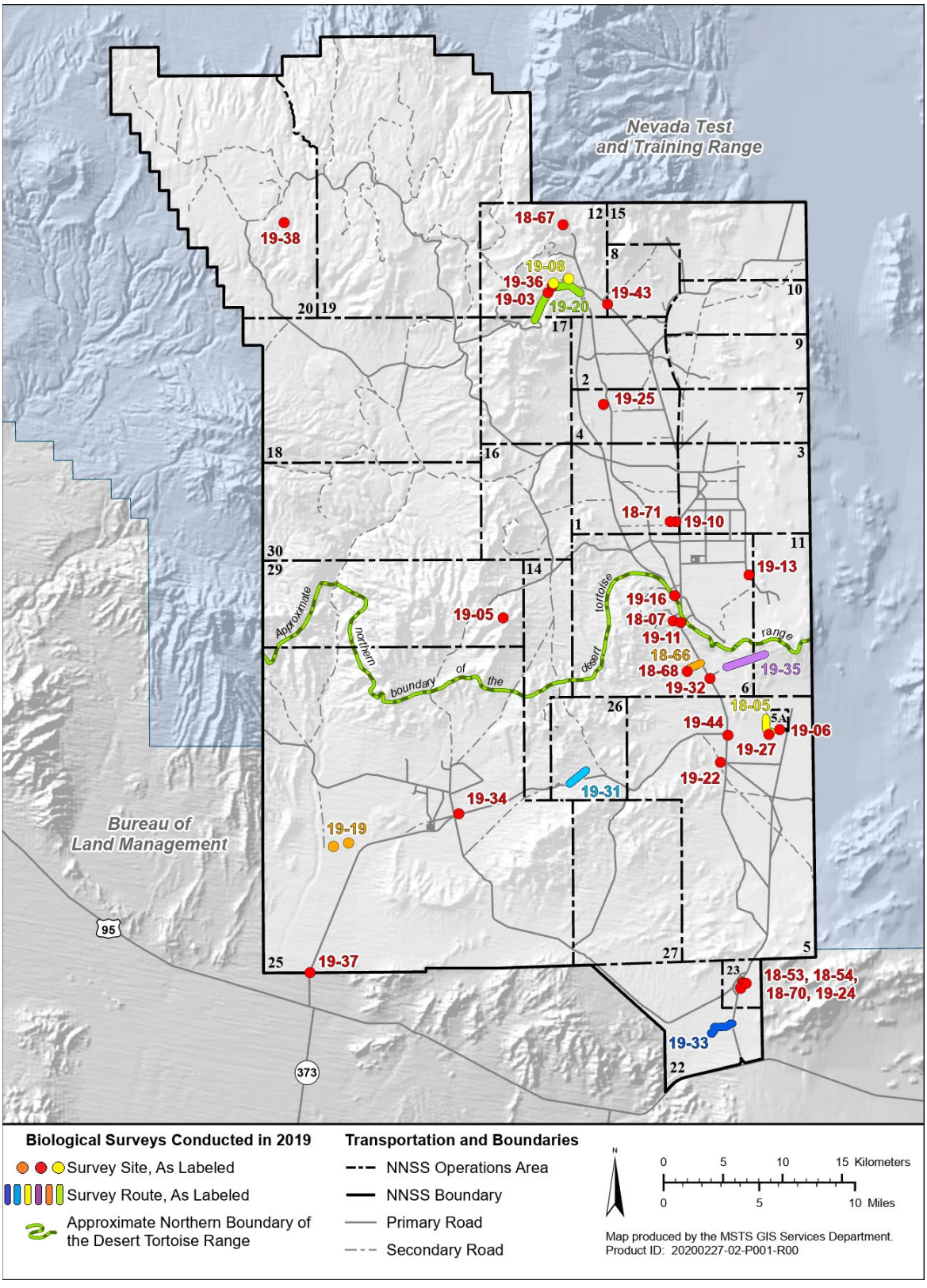

Figure 2-1. Biological surveys conducted in 2019. Projects 19-08 and 19-19 each had two survey locations.

Table 2-2. Summary of biological surveys conducted on the NNSS during 2019.

Project No.	Project Name	Important Species/Resources Found	Area Surveyed (ha)	Project area in Undisturbed Habitat (ha)	Mitigation Recommendations
18-05 [a]	RWMC Expansion (New Berm and Channel and small section in tortoise habitat in NW corner)	Juvenile tortoise pallet, predator burrows, Yucca, cacti	7.00	4.60	Formal consultation, TCS [b], DTM [c], pre-activity survey for area outside tortoise habitat
18-07	CP Water Line Replacement	Yucca, cacti	1.20	1.02	Formal consultation, TCS [b], DTM [c], pre-activity survey for area outside tortoise habitat
18-53	Mercury Demo Phase II	Dead bat, bat sign, antelope sign, cacti	2.86	0	Pre-activity survey for buildings
18-54	Mercury Demo Phase III	Bat sign	NA	NA	Pre-activity survey for buildings
18-66	DAF Utility Line	Predator burrows, Yucca, cacti	6.02	2.26	Formal consultation, TCS [b], DTM [c]
18-67	PE-1	Western red-tailed skink habitat, pine trees, cacti, deer sign, bird activity	6.90	Project in Progress	Pre-activity survey to identify protected species, 2nd pre-activity survey for ground-disturbing activities, avoid skink habitat
18-68	DAF UPS Upgrade	Yucca, cacti	0.30	0	TCS [b]
18-70	Storage Container Installation	Cacti	0.03	0	TCS [b], avoid Yucca and cacti if possible
18-71	U1a Modernization	2 potential bird nesting sites, predator burrow, antelope sign, Yucca, cacti	72.85	Project in Progress	Pre-activity survey, 2nd pre-activity survey if bird nesting habitats will be disturbed
19-03	Pole Replacement FAJ-3	Deer sign, Yucca	0.32	0	Pre-activity survey, avian friendly poles
19-05	Pole Replacement DAI-50	Pine trees, cacti	0.32	0	Pre-activity survey, avian friendly poles, avoid pine trees and cacti if possible
19-06 [a]	New Well RWMC	Burro sign, cacti	1.20	0.60	TCS [b], avoid cacti habitat if possible
19-08	Telecom Trenches Area 12	None	1.40	0	Pre-activity survey
19-10	Air Supply Borehole	None	2.00	Project in Progress	Pre-activity survey
19-11	Trailer Relocation	None	NA	NA	Pre-activity survey for buildings
19-13	Chip & Seal Tweezer Rd	Antelope sign	0.20	0	Pre-activity survey for location of sensitive plant species
19-16	Area 6 Tippipah Batch Plant	Predator burrows, antelope sign, Yucca, cacti including one sensitive cactus species	8.85	Project in Progress	Formal consultation, TCS [b], DTM [c]
19-19	Water Line Break Area 25 (2 Different Locations)	None	0.03	0	TCS [b]
19-20 (18-43, 17-12)	Power Pole Vegetation Abatement	Deer and horse sign, red-tailed hawk, pine trees, cacti	4.30	0	Pre-activity survey
19-22	SERDP Research Plots	Burro sign	2.00	0	TCS [b]
19-24	400 Series Dorm Demolition	Bat sign, one dead unknown bird	NA	NA	Pre-activity survey for buildings

Table 2-2. Summary of biological surveys conducted on the NNSS during 2019 (continued).

Project No.	Project Name	Important Species/Resources Found	Area Surveyed (ha)	Project area in Undisturbed Habitat (ha)	Mitigation Recommendations
19-25	Heliotrope Launch Pad	Horse sign, cacti	1.10	0	Pre-activity survey
19-27 [a]	Soil Stockpile RWMC	Predator burrows	0.80	0.50	TCS [b]
19-31	Blading Around Phoenix Site	Predator burrows (1 used by adult tortoise, 2 used by juvenile tortoise), Yucca	10.10	0	TCS [b], avoid flagged burrows and Yucca
19-32	Pole Replacement DAE-403	None	0.08	0	Pre-activity survey, avian friendly poles
19-33	Blading Roads DRA	Antelope sign, Yucca, cacti	2.95	0	TCS [b]
19-34	Area 25 Fire Station Yard Clean-up	None	NA	NA	Pre-activity survey for buildings
19-35	Blading Area 11 EODU	1 sensitive plant species	4.20	0	Pre-activity survey, document sensitive plant species before and after blading
19-36	A12 Waterline Break Repair	None	0.25	0	Pre-activity survey
19-37	New Security Signs Gate 510	Burrow sign	0.20	0	TCS [b]
19-38	Sump Liner Replacement	Pine trees, bird activity	1.86	0	Pre-activity survey
19-43	DTRA Sensor Locations Rainier	Predator burrow	1.50	0	Pre-activity survey, avoid flagged burrow if possible
19-44	Emergency Phone Access Blading	None	0.40	0	TCS [b]
		Total	**141.22**	**8.98**	

[a] Within the Frenchman Flat desert tortoise exclusion zone
[b] Tortoise Clearance Survey
[c] Desert Tortoise Monitor

3.0 *DESERT TORTOISE COMPLIANCE*

Desert tortoises occur within the southern one-third of the NNSS. This species is listed as threatened under the *Endangered Species Act*. In December 1995, NNSA/NFO completed consultation with the U.S. Fish and Wildlife Service (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 desert 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 new Programmatic Biological Opinion (Opinion) on August 27, 2019 (FWS 2019-2).

Desert tortoise compliance on the NNSS was covered under two Opinions in 2019; the February 12, 2009 through August 26, 2019 Opinion (FWS 2009) and the new Opinion beginning August 27, 2019 covering the next ten years (FWS 2019-2). Updates to the new Opinion allow the NNSS to proceed with projects less than 20 acres (ac) or linear projects less than one mile in length without further consultation with FWS, while still complying with the protective measures for the desert tortoise outlined in the Opinion. The tortoise exclusion zones identified in the 1996 Opinion (areas designated as having such low tortoise presence they were exempt from the terms and conditions under the Opinion and continued to remain in effect through August 26, 2019) were eliminated based on recent tortoise observations with in the zones. Notable updates to the Opinion also include more detailed protective measures to ensure fewer tortoise mortalities and injuries during projects and activities on the NNSS.

The Desert Tortoise Compliance task of EMAC implements the protective measures of the 2019 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 MSTS staff biologists in 2019, including (a) conducting 100% coverage tortoise clearance surveys (TCS) at project sites within 24 hours from the start of project construction, (b) ensuring projects have a 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

Twenty-six projects occurring within the range of the desert tortoise were reviewed by biologists in 2019 and three projects in progress were carried over from 2018 (Table 3-1). The review process to determine the impacts each project may have on the desert tortoise was streamlined with updates from the new Opinion (FWS 2019-2). Projects are now 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 desert tortoise (surveys may still be completed 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).

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 is required within 24 hours before the start of a project when there is a possibility that a tortoise may be in the project area, adjacent land or if there is a possibility a tortoise may wander into the project area during construction activities. A pre-activity survey is completed by walking meandering transects or the entire area and is required when there is no possibility of a tortoise being encountered

Table 3-1. Summary of projects within the range of the desert tortoise that were reviewed, compliance activities required, surveys completed in 2019, and amount of tortoise habitat disturbed.

Project No.	Project Name	Description of Compliance Activity Required	Survey Completed During 2019	Tortoise Habitat Disturbed (ha)
18-05 [a]	RWMC Expansion [a]	Pre-activity Survey (meandering transects), Post Activity Survey	✓	0
18-07 [a]	CP Water Line Replacement [a]	Tortoise Clearance Survey	✓	0
18-09 [a]	Test Bed South [a]	No Activities in 2019		0
18-53	Mercury Demo Phase II	Pre-activity Survey (Buildings)	✓	0
18-54	Mercury Demo Phase III	Pre-activity Survey (Buildings)	✓	0
18-66	Area 6 Buried Utility Line	Tortoise Clearance Survey	✓	In Progress [b]
18-68	Area 6 UPS Upgrade	Pre-activity Survey (100% coverage)	✓	0
18-70	Storage Container Installation	Pre-activity Survey (100% coverage)	✓	0
19-06	New Well RWMC	Tortoise Clearance Survey	✓	0
19-11	Trailer Relocation	Pre-activity Survey (Buildings)	✓	0
19-12	DoD Exercise	None		0
19-14	Area 24 Telecom Trenches	None		0
19-16	Area 6 Tippipah Batch Plant	Tortoise Clearance Survey	✓	In Progress [b]
19-17	Mercury Sewer Line Phase II	None		0
19-18	Area 6 Turn Around	None		0
19-19	Water Line Breaks Area 25	Pre-activity Survey (100% coverage)	✓	0
19-22	SERDP Research Plots	Pre-activity Survey (100% coverage)	✓	0
19-23	Dirt Road Grading	None		0
19-24	400 Series Dorm Demolition	Pre-activity Survey (Buildings)	✓	0
19-27	Soil Stockpile RWMC	Pre-activity Survey (100% coverage)	✓	0
19-28	Foundry Ops Area 26	None		0
19-31	Blading Around Phoenix Site	Pre-activity Survey (100% coverage)	✓	0
19-32	Pole Replacement DAE-403	Pre-activity Survey (100% coverage)	✓	0

Table 3-1. Summary of projects within the range of the desert tortoise that were reviewed, compliance activities required, surveys completed in 2019, and amount of tortoise habitat disturbed (continued).

Project No.	Project Name	Description of Compliance Activity Required	Survey Completed During 2019	Tortoise Habitat Disturbed (ha)
19-33	Blading Roads DRA	Pre-activity Survey (100% coverage)	✓	0
19-34	Area 25 Fire Station Yard Clean-up	Pre-activity Survey (Buildings)	✓	0
19-35	Blading Area 11 EODU	Pre-activity Survey (100% coverage)	✓	0
19-37	New Security Signs Gate 510	Tortoise Clearance Survey	✓	0
19-42	SDRD RSL 2020	None		0
19-44	Emergency Phone Access Blading	Tortoise Clearance Survey	✓	0
		Total		**0**

[a] Project carried over from 2018.
[b] Habitat disturbance will be reported upon project completion

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 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.

Twenty-one surveys were completed by biologists within the range of the desert tortoise in 2019, with one project, 19-19, having two survey locations (Figure 3-1). No desert tortoises were observed or reported injured or killed during projects. Post-activity surveys confirm the amount of desert tortoise habitat disturbed for each project. Desert tortoise habitat was not disturbed during 2019. Two in-progress projects (18-66 and 19-16) are scheduled to disturb tortoise habitat. The disturbance will be documented upon project completion and completion of a post-activity survey. All projects that were monitored within tortoise habitat remained within the surveyed area. This is determined by means of delineating the area of disturbance and constant communication between ground crews and biologists.

In January 2020, the annual report summarizing tortoise compliance activities conducted on the NNSS from January 1 through December 31, 2019 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 desert tortoise; (b) the number of desert 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.

Compliance with the Opinion ensures the desert tortoise is protected on the NNSS and the cumulative impacts on this species are minimized (DOE/NV 1998). 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

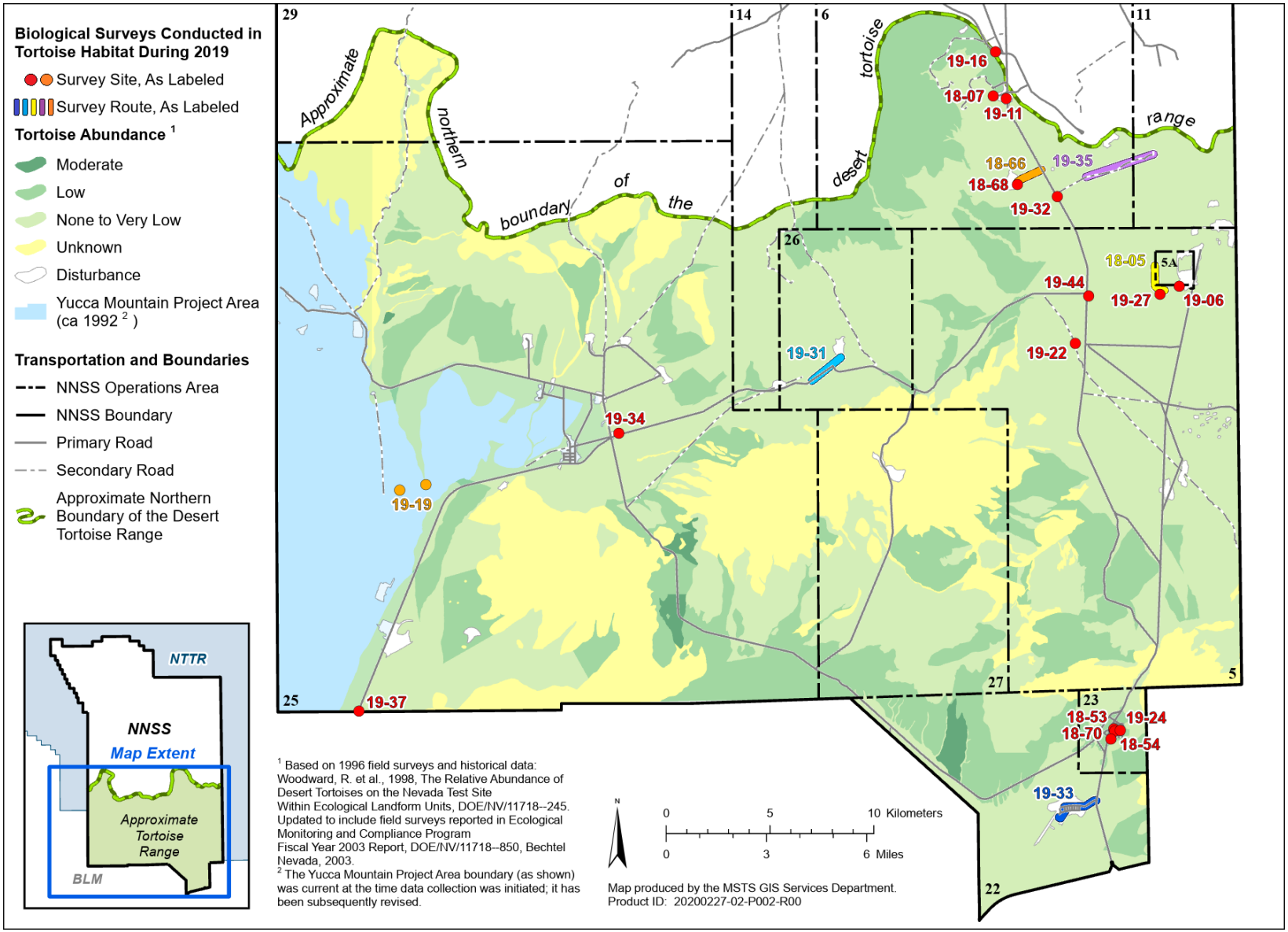

Figure 3-1. Biological surveys conducted within the range of the desert tortoise in 2019 (Project 19-19 had two survey locations).

NNSS are parameters that should be measured and monitored annually. With the transition to the new Opinion in August 2019, the 2009 Opinion's take limits were totaled, finalized, and reported to FWS (Table 3-2). Take amounts and renegotiated limits began on August 27, 2019 with the new Opinion going into effect (Table 3-3).

There were 66 reported desert tortoise roadside sightings during 2019 (Figure 3-2). Fifty-four of the encountered tortoises were determined to be in harm's way and moved off the road (Figure 3-2) in accordance with FWS-approved tortoise handling procedures. Of the 54 tortoises handled, 52 were considered incidental take (Table 3-2 and 3-3). Per FWS, beginning August 27, 2019, only large tortoises (≥180 millimeters [mm] in length) shall be counted as incidental take. Small tortoises (<180 mm in length) that are encountered will be reported to FWS but not counted as incidental take due to their low detectability.

Amongst the 54 tortoises moved off NNSS roads, one was a juvenile tortoise found with active bird predation wounds on its carapace (Figure 3-3). The tortoise was alive, taken to a veterinarian and later euthanized for its life-threatening injuries. Another of the encounters was an attempted canid predation (Figure 3-3). The tortoise was found flipped upside down on a road, with active puncture wounds on the anterior and posterior carapace. The predation injuries were not life threatening. The tortoise was moved well off the road and placed under a boulder. The tortoise was checked on the following day and was not observed. Tortoises have several predators in the wild including ravens (*Corvus corax*), coyotes (*Canis latrans*), and kit foxes (*Vulpes macrotis*). When a tortoise is found with predation injuries, FWS is contacted to determine the best action for the well-being of the animal.

As theorized by biologists, many of the tortoise encounters on roads are the same animals crossing the roads multiple times, termed repeat offenders. As determined through a study from 2012 through 2018, many tortoises have home ranges that overlap NNSS roads and these animals cross these roads many

Table 3-2. Cumulative incidental take (February 12, 2009 – August 26, 2019) and maximum allowed take for NNSA/NFO programs.

Program	Number of Hectares Impacted (maximum allowed)	Number of Tortoises Anticipated to be Incidentally Taken (maximum allowed)	
		Killed/Injured	Other
Defense	2.27 (202)	0 (1)	0 (10)
Waste Management	3.08 (40)	0 (1)	0 (2)
Environmental Restoration	0 (4)	0 (1)	0 (2)
Non-Defense R&D	2.95 (607)	0 (2)	0 (35)
Work for Others	14.50 (202)	0 (1)	0 (10)
Infrastructure Development	4.01 (40)	0 (1)	1 (10)
Roads	0 (0)	14 (15) [a]	229 (125) [b]
Totals	**26.81 (1,095)**	**14 (22)**	**230 (194)**

[a] No more than 4 desert tortoises killed on roads during any calendar year and no more than 15 killed on roads during the term of the Opinion.
[b] Take limit was exceeded during calendar year 2017. Requested concurrence to continue moving tortoises off roads when in harm's way was authorized by FWS on June 5, 2017.

Table 3-3. Summary of disturbance of tortoise habitat limits, actual disturbances, anticipated level of incidental take of large tortoises (≥180 mm), and actual incidental take of large tortoises August 27, 2019 – December 31, 2019.

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	9 (350)[b]	0 (15)[c]
2) Defense	0 (202)	0 (10)	0 (2)
3) Waste Management	0 (101)	0 (10)	0 (2)
4) Environmental Restoration	0 (101)	0 (10)	0 (2)
5) Nondefense Research and Development (R&D)	0 (405)	0 (20)	0 (4)
6) Work-for-Others	0 (202)	0 (20)	0 (2)
7) Infrastructure	0 (202)	0 (20)	0 (4)[d]
Totals	**0 (1,213)**	**9 (440)**	**0 (31)**

[a] All desert tortoises observed in harm's way may be moved to a safe location
[b] No more than 35 non-injury or non-mortality tortoises in a given year
[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

times throughout the active season. Three tortoises that were previously marked with identification numbers were moved again off roads in 2019: NNSS14, NNSS16 and NNSS20 (Figure 3-2). Tortoise NNSS16 was moved off the road twice; once in August and once in September. Two of the roadside sightings were roadkills. The first was a juvenile tortoise found on June 20, 2019 on a dirt road in Area 5 (Figure 3-2). The location was within a tortoise exclusion zone and provided information for the elimination of these zones during consultation for the new Opinion (FWS 2019-2). The second was an adult tortoise found on June 21, 2019 on Jackass Flats Road in Area 22 (Figure 3-2). Both road mortalities were reported to FWS and as incidental take (included in Table 3-2).

3.1.1 Mitigation for Loss of Tortoise Habitat

Prior to land-disturbing activities associated with any projects of the Work-for-Others program, the proponent shall pay remuneration fees to minimize effects from disturbance of desert tortoise habitat on the NNSS in accordance with FWS-approved instructions (FWS 2019-2). 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 desert tortoise habitat by funding and implementing FWS-approved conservation actions on the NNSS (FWS 2019-2). Remuneration fees are currently paid into the Clark County Desert Conservation Program for all Work-for-Others projects at the rate of $902 per acre of disturbance. All other projects are able to 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 $902 per acre of disturbance.

Three projects under the Infrastructure Program were required to pay remuneration fees based on each project's permanent disturbance of desert tortoise habitat. Project 18-66 has the potential to disturb 5.5 ac,

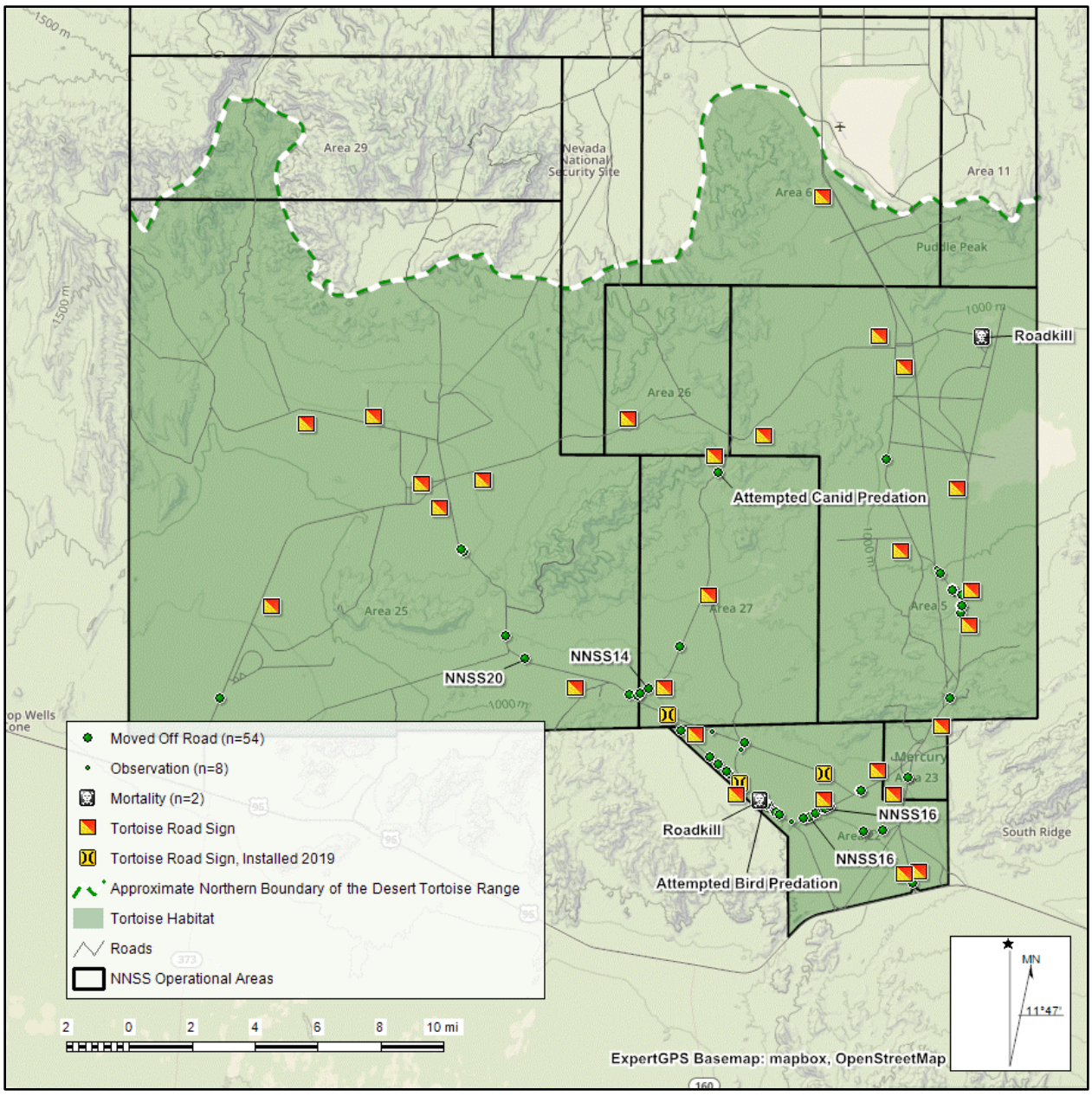

Figure 3-2. Locations of existing tortoise awareness road signs, new road signs installed in 2019, tortoise roadside sightings (including tortoises moved off roads), and two tortoise road mortalities during 2019. Note that two locations of tortoises being moved off roads could not be confirmed and were not mapped.

Figure 3-3. Juvenile tortoise (left) with active bird predation puncture wounds, later euthanized by a veterinarian. Adult tortoise (right) with active canid wounds relocated off a road.

(Photos by D.B. Hall, June 20, 2019 [left] and November 6, 2019 [right]).

project 18-07 has the potential to disturb 15 ac, and project 19-16 has the potential to disturb 85 ac. Amounts of $4,961 (5.5 ac at $902 per ac), $13,530 (15 ac at $902 per ac), and $76,670 (85 ac at $902 per ac) have been deducted from accrued funds, respectively.

3.2 CONSERVATION RECOMMENDATIONS

Biologists continue to increase tortoise awareness by updating and increasing tortoise signage throughout the NNSS. This year three faded tortoise awareness signs were replaced along access road entrances into the juvenile translocation study area (Figure 3-4). The locations of the signs are shown in Figure 3-2.

Two desert tortoise conservation research studies have been approved by FWS and are being implemented by MSTS biologists; the desert tortoise road study and the juvenile translocation study. The following is a synopsis of activities conducted for each of these projects.

Figure 3-4. New tortoise sign for the juvenile translocation study area.

(Photo by J.A. Perry January 3, 2019).

3.2.1 Road Study

Per the Opinion, NNSA/NFO developed a desert tortoise study which focused on collecting fine-scale patterns of roadside habitat use by the desert tortoise for application in the future development and implementation of management practices in order to minimize road mortalities on the NNSS (FWS 2009).

The research project was appended to the Opinion in April 2012 and implemented in May 2012. The main objectives of this study were to (1) determine fine-scale patterns of habitat use of desert tortoises found near roads on the NNSS, and (2) assess the risk of desert tortoise road mortality on the NNSS. A secondary objective was to assess the health and condition of desert tortoises on the northern periphery of their range. FWS originally approved a handling take limit of twenty adult tortoises for the project and later approved the sample size increase to thirty adult tortoises. Field work for the study came to completion in September 2018. Preliminary results of the study were included in the 2018 EMAC report. A more detailed topical report is in progress.

Because the largest threat to the desert tortoise on the NNSS is roads, research will continue on this topic. Biologists proposed an opportunistic mark-recapture study to continue documentation and research on tortoises whose home ranges overlap NNSS roads to FWS during consultation of the new Opinion in 2019. The study was approved by FWS under the Opinion and allows permitted biologists to attach identification numbers to tortoises when they are found and moved safely off NNSS 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). Field work for the study will begin in spring 2020 and continue through the duration of the Opinion.

3.2.2 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 Institute for Conservation Research (ICR). 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 2019. During 2019, monitoring occurred once in January and February; weekly in March, April and May; twice in June, July, and August; three times in September; weekly in October, twice in November and once in December. Additional monitoring was conducted in January 2020 to determine each tortoise's winter burrow. At the beginning of 2019, 24 of 60 (40%) tortoises were alive. At the end of the year, 23 of the 60 (38.3%) tortoises (8 female, 15 male) were known to be alive (Table 3-4, Figure 3-5). One male tortoise (4040) went missing on October 14, 2019. All that was found was its transmitter that had bite marks on it but no carcass or remains were found. It is assumed dead but a search will be made in the spring to try to locate it. Figure 3-5 shows the release locations for all 60 translocated juveniles, the winter burrows for the surviving 23 tortoises, and the location of the presumed dead tortoise.

After 88 months post-release, 23 of the 60 juveniles were still alive (38.3% survival). This is somewhat higher but similar to an estimated 33% survival (20 of 60 tortoises alive) based on an annual survival rate of 0.85 that Turner et al. (1987) calculated in a natural population. There is a much higher survival rate for males (50% [15 of 30]) compared to females (28% [8 of 29]) with most of the mortalities suspected as coyote and kit fox 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 lead 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 and 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 increases. Understanding differential mortality in both resident and translocated juvenile tortoises of both sexes warrants further study.

Table 3-4 contains information about the 24 juvenile tortoises monitored during 2019. On average, the distance between the release location and winter 2019-2020 burrow (i.e., the burrow a juvenile was in during the first part of January 2020) was 789 m (range 77–6,367 m; standard deviation [sd] 1,350 m). On average, tortoises used winter burrows in 2020, 78 m away from their 2019 winter burrows. Over two-thirds (16 of 23) of the tortoises wintered in burrows within 100 m of their last year's winter burrow, and 30% (7 of 23) of them used the same winter burrow as the previous year.

Table 3-4. Mortality, sex, distance in meters (m) between release site and January 2020 burrow, distance between January 2019 burrow and January 2020 burrow, total distance between monitored locations (January 2019 to January 2020), and total number of burrows and new burrows occupied by 24 juvenile desert tortoises monitored during 2019.

Tortoise Number	Sex	Distance (m) Release to Winter 2019-2020	Distance (m) Jan. 19 burrow to Jan. 20 burrow	Total Distance (m) between locations Winter 2019-2020	Number of burrows used (New burrows)
4010	Female	1232	0	1886	3 (1)
4014	Female	564	45	563	5 (2)
4030	Female	2593	228	730	4 (1)
4039	Female	283	237	4363	4 (3)
4044	Female	215	0	1740	3 (0)
4045	Female	188	0	1048	6 (3)
4046	Female	369	68	4795	5 (2)
4049	Female	1242	15	3225	6 (5)
4004	Male	156	100	2194	7 (3)
4005	Male	243	0	2004	3 (0)
4007	Male	149	9	781	7 (3)
4011	Male	334	13	4852	4 (2)
4019	Male	519	180	5303	8 (3)
4024	Male	1199	165	3952	6 (5)
4025	Male	1038	64	1439	7 (2)
4033	Male	124	0	693	5 (3)
4034	Male	215	0	1592	6 (4)
4036	Male	575	0	3431	5 (2)
4038	Male	114	136	2477	5 (4)
4040*	Male	NA	NA	1522	5 (3)
4041	Male	77	55	1013	5 (2)
4048	Male	89	243	3699	8 (6)
4053	Male	274	50	1227	3 (0)
4055	Male	6367	194	1927	3 (1)
	Average	789	78	2352	5.1

*Found transmitter on October 14, 2019, presumed dead
NA = Not applicable

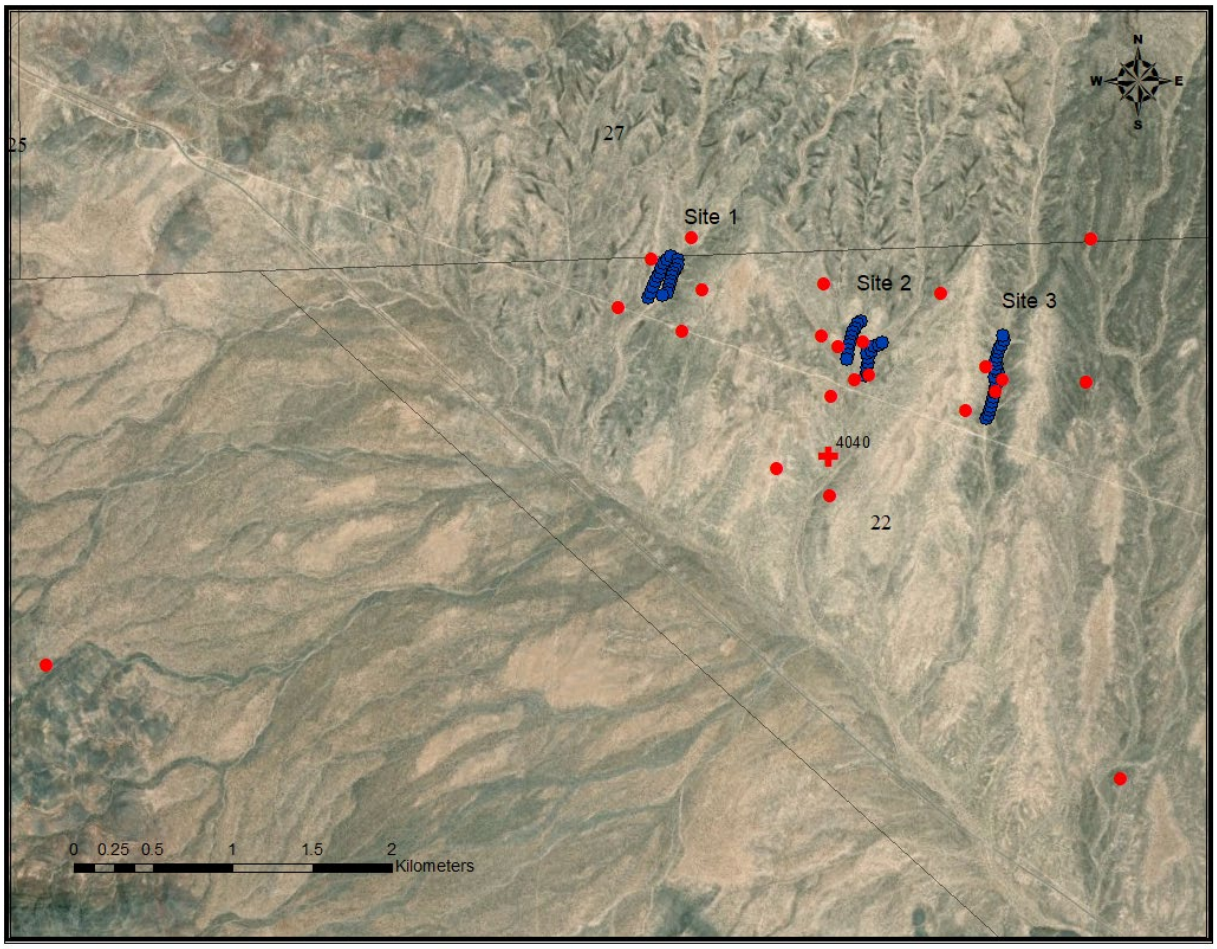

Figure 3-5. Release locations for 60 tortoises, September 2012 (blue dots, 20 at each site) and locations for 23 tortoises (red dots) January 2020. The red cross is the location of the transmitter for 4040, assumed to be dead.

The distance (m) between monitoring checks was calculated and is summarized in Table 3-4. This is not the total distance a tortoise moved during the year, but the summed distance between locations recorded during regular monitoring. It is important to note that movements tortoises made between monitoring checks were not recorded or measured. For females the average distance moved was 2,294 m, and for males 2,382 m. A two-tailed, t-test was used to determine if this difference was statistically significant at α (alpha level) = 0.05. It was not significant (p [probability] = 0.9).

During 2019, burrows were marked with unique numbers and data collected included Universal Transverse Mercator (UTM) coordinates (North American Datum [NAD] 83), 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. It is important to note that tortoise burrows were only documented during tracking checks, and therefore all burrows used may not have been documented. A total of 122 unique burrows were used by the 24 tortoises, and the number of new burrows marked and measured during 2019 was 60. The average height of burrows was 10.5 mm (range 6-25 mm; sd 3.0 mm) and average width of burrows was 22.9 mm (range 15-30 mm; sd 3.6 mm). On average, tortoises used 5.1 unique burrows (range 3-8; sd = 1.6) (Table 3-4) with no significant difference between females (4.5 burrows) and males (5.4 burrows) ($p = 0.13$). One burrow (#482) was occupied by two different tortoises; Female 4044 in May and Male 4019 in October. Timing

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 2014–2019.

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

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). Precipitation during summer and fall was sparse, resulting in little food for tortoises to eat. Three tortoises moved burrows between mid-November and early December probably in response to significant moisture received in late November that collapsed a few burrows.

Observations made while tracking from January 2019 to January 2020 on the 24 surviving juvenile tortoises totaled 787. Tortoises were inside burrows 63% of the time and aboveground 37% of the time including under vegetation or a boulder (23%), in the open (10%), in the burrow mouth (4%), or on the burrow apron (1%) (Figure 3-6). Of the 174 observations under vegetation, 52.3% were under blackbrush (*Coleogyne ramosissima*), 14.9% were under Nevada jointfir (*Ephedra nevadensis*), 7.5% were under mixed shrub species clumps, and the remaining 25% under 10 other shrub species including 5.7% pale desert thorn (*Lyicum pallidum*); 5.2% water jacket (*Lycium andersonii*); 5.2% Fremont's dalea (*Psorothamnus fremontii*); 4.0% creosote bush (*Larrea tridentata*); 1.7% burrobrush (*Hymenoclea salsola*); and spiny hopsage (*Grayia spinosa*), threadleaf snakeweed (*Gutierrezia microcephala*), winterfat (*Krascheninnikovia lanata*), spiny menodora (*Menodora spinescens*), and Mojave Yucca (*Yucca schidigera*) all < 1.0% (Figure 3-7). It is noteworthy that more than half of the tortoise observations under vegetation were under blackbrush. Additional studies are needed to determine if there is a preference for blackbrush or if it is just the dominant shrub.

For the 60 new burrows, tortoises used burrows on wash slopes over 70% of the time followed by burrows in wash bottoms and washlets (Figure 3-8). Vegetation cover at burrows was found at 95% of the burrows, suggesting this may be an important factor in burrow use for these juveniles. Mixed shrub clumps seemed to be the dominant cover followed by Nevada jointfir, creosote bush, pale desert thorn, burrobrush, and white bursage (*Ambrosia dumosa*). Fourwing saltbush (*Atriplex canescens*), blackbrush, and water jacket made up the other category (Figure 3-9).

Gravel was the dominant substrate and was observed at over one-third of all new juvenile tortoise burrows (Figure 3-10), followed by cobble, gravel/cobble and sandy/gravel. 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 solid rock is bedrock. The other category is made up of cobble/rock (6.7%), sandy (6.7%), sandy/cobble (3.3%), sandy/gravel/cobble (1.7%), and sandy/rock (1/7%). Combined categories such as gravel/cobble means that both were equal in abundance.

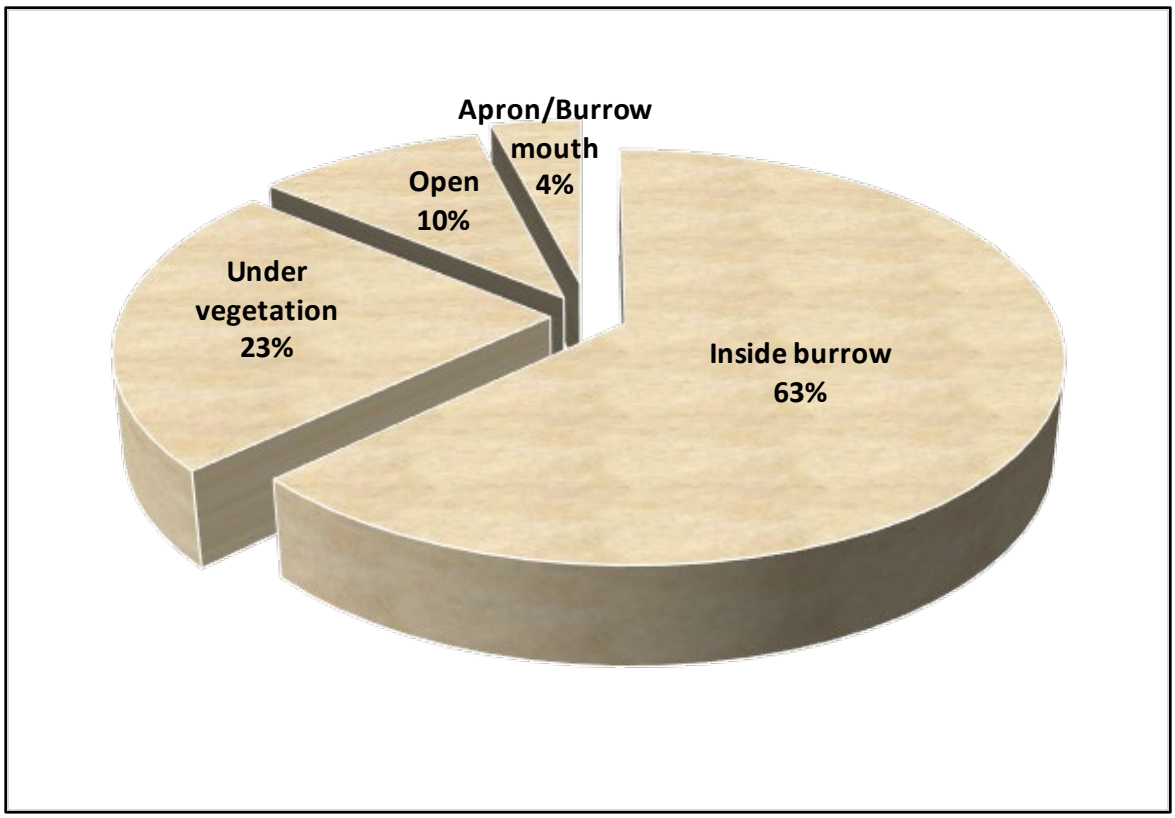

Figure 3-6. Percentage of observations (n=787) of 24 juvenile tortoises by location, January 2019–January 2020.

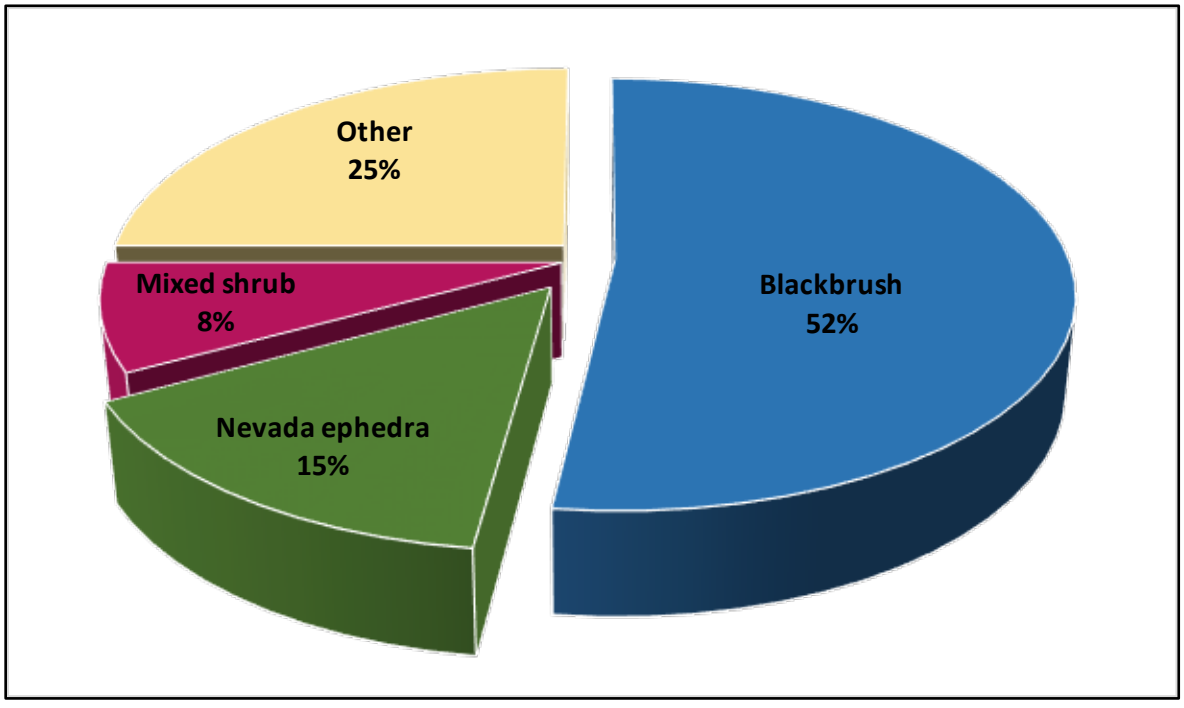

Figure 3-7. Percentage of observations (n=174) of 24 juvenile tortoises found under vegetation by species, January 2019–January 2020.

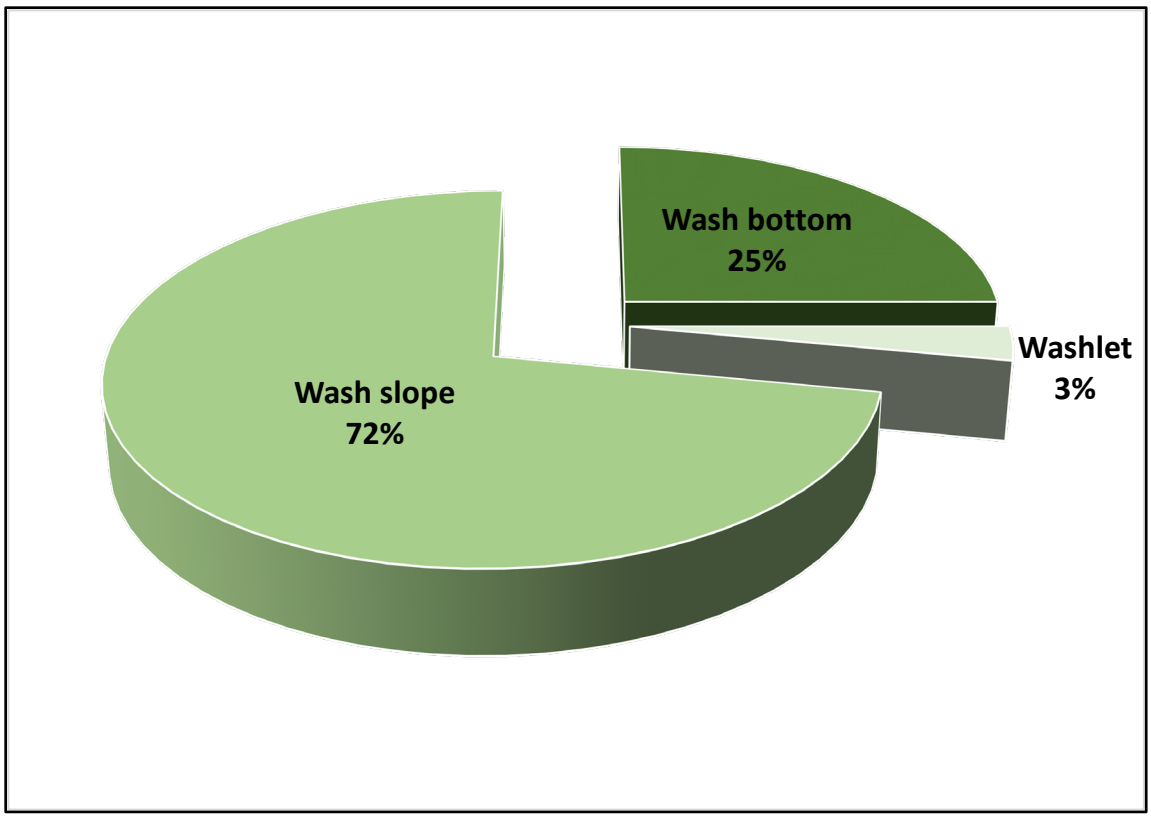

Figure 3-8. Percentage of new juvenile tortoise burrows by topographic position, January 2019–January 2020 (n=60).

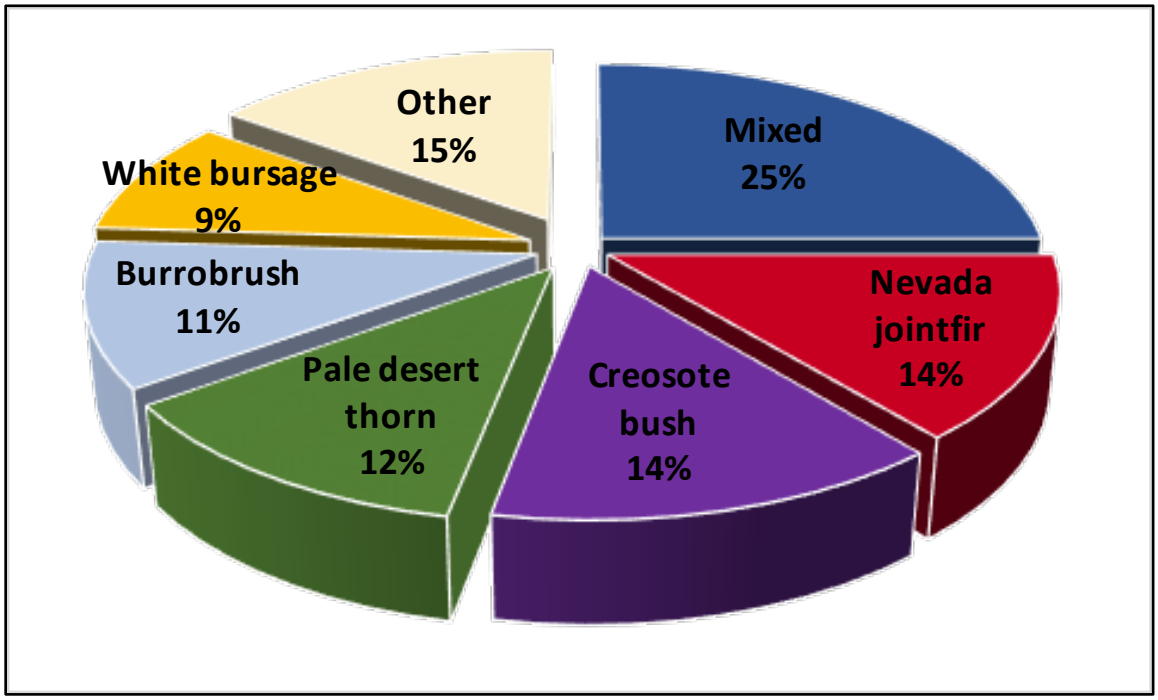

Figure 3-9. Percentage of new juvenile tortoise burrows by vegetation cover at the burrow, January 2019–January 2020 (n=57).

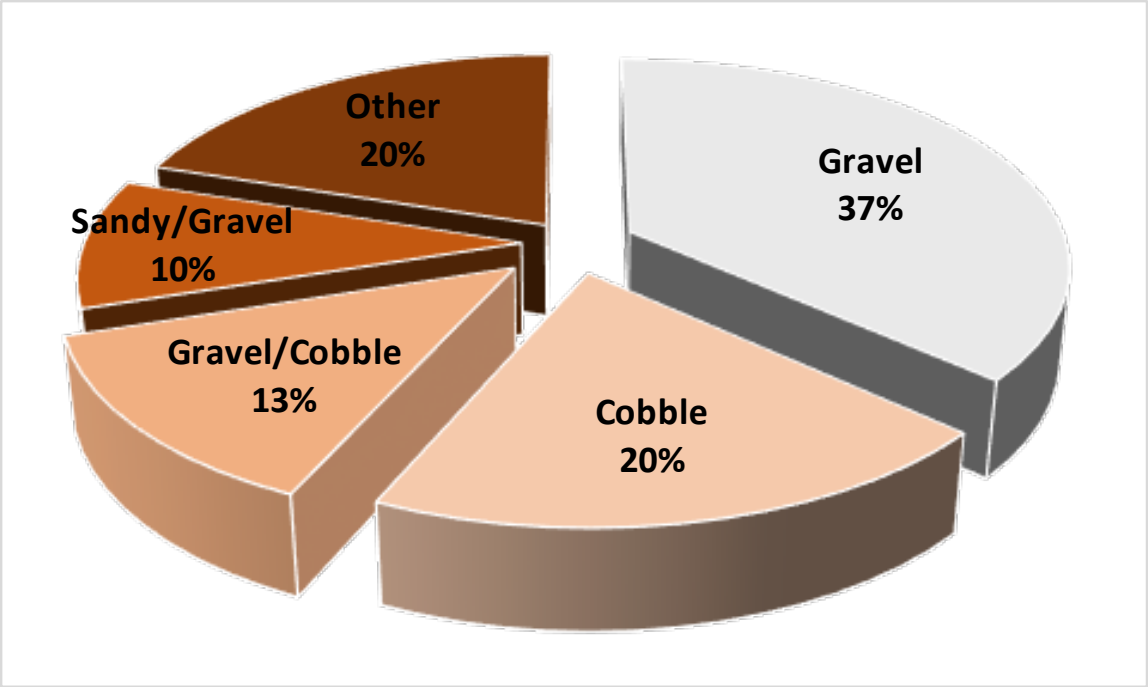

Figure 3-10. Percentage of juvenile tortoise burrows by substrate, January 2019–January 2020 (n=60).

Evidence of foraging was documented for all 24 tortoises 152 times between March 26 and October 1, 2019, with foraging peaks in April (73 times) and May (51 times) (Figure 3-11). The most common observed species eaten were bluedicks (*Dichelostemma capitatum*) (5.9%) (Figure 3-12), desert globemallow (*Sphaeralcea ambigua*) (1.3%), and desert dandelion (*Malacothrix glabrata*) (1.3%). Nine other species were observed being eaten by tortoises one time each: whitemargin sandmat (*Chamaesyce albomarginata*), cleftleaf wildheliotrope (*Phacelia crenulata*), Arabian schismus (*Schismus arabicus*), brittle spineflower (*Chorizanthe brevicornu*), redstem stork's bill (*Erodium cicutarium*), *Langloisia* spp., Pacific blazingstar (*Mentzelia obscura*), yellow cups (*Camissonia brevipes*), and brightwhite (*Prenanthella exigua*). Most (85%) of the time, it was not possible to identify what the tortoises had eaten. One tortoise (4046) was observed eating dirt on May 22, 2019. Winter and spring precipitation was nearly double the average amount and temperatures remained relatively cool into June. Vegetation production was high during the spring green-up and there was an abundant, diverse community of native forbs available for tortoises to forage on, especially during April and May. Fortunately, the cool, wet spring was not very conducive to brome growth in un-burned areas. Due to the cooler temperatures, most tortoises did not become active until the end of March or first part of April which explains the low number of foraging observations in March. Summer/fall precipitation was below normal which resulted in reduced plant production and reduced foraging opportunities during this time period.

All transmitters were changed in the fall, and health assessments were conducted at the time of transmitter changes except for one tortoise (4030) which could not be extracted from a deep burrow. Tortoises were also measured, weighed and given a Body Condition Score (BCS) (1-3 = under condition, 4-6 = good condition, 7-9 = over condition) in both spring and fall. Table 3-6 contains information on midline carapace length (MCL) (mm) and BCS for fall 2012 (pre-release), spring 2019 and fall 2019 and weight without transmitter (g) for fall 2012 (pre-release) and fall 2019.

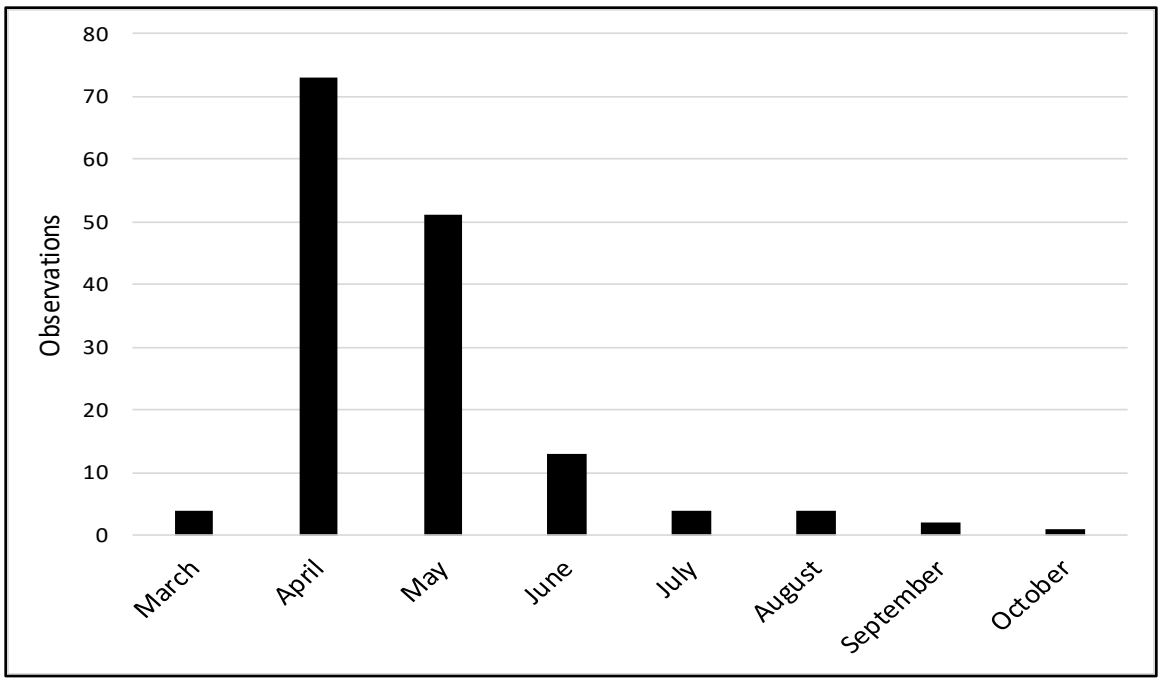

Figure 3-11. Number of times evidence of foraging was detected by month for 24 juvenile tortoises, January 2019–January 2020 (n = 152) (no evidence of foraging was detected in November, December, January, or February).

Figure 3-12. Female tortoise (#4045) eating bluedicks, April 2019.

(Photo by D.B. Hall April 15, 2019).

Table 3-6. Midline carapace length (MCL) (mm), weight without transmitters (gram [g]), and body condition score in Fall 2012, Spring 2019, and Fall 2019, including MCL growth and weight gain from Fall 2012 to Fall 2019 and MCL growth Spring 2019 to Fall 2019 for 24 tortoise monitored in 2019.

Tortoise Number	Sex	Pre-release MCL (mm) 2012	MCL (mm) (Spring 2019)	MCL (mm) (Fall 2019)	MCL Growth (mm) (2012-2019)	Growth (mm) Spring 2019 to Fall 2019	Pre-release Weight (g) (2012)	Weight (g) (Fall 2019)	Weight gain (g) (2012-2019)	Pre-release Body Condition (2012)	Body Condition (Spring 2019)	Body Condition (Fall 2019)
4010	Female	142	172	182	40	10	590	1150	560	4	4.5	4.5
4014	Female	136	158	169	33	11	485	828	343	5	4	4
4030*	Female	148	182	*	*	*	562	*	*	4	4.5	*
4039	Female	117	154	161	44	7	315	900	585	5	5	5
4044	Female	146	173	190	44	17	484	1150	666	4	4.5	4.5
4045	Female	129	158	165	36	7	400	815	415	4	4	4.5
4046	Female	126	171	187	61	16	476	1200	724	4	4	4
4049	Female	106	139	149	43	10	238	623	385	4	4	4
4004	Male	117	152	165	48	13	303	807	504	4	4.5	4
4005	Male	140	169	182	42	13	564	1200	636	5	5	4
4007	Male	121	132	141	20	9	363	546	183	5	4	4
4011	Male	144	200	215	71	15	634	1600	966	4	4.5	4.5
4019	Male	150	206	215	65	9	654	1600	946	4	4.5	4.5
4024	Male	146	205	214	68	9	565	1650	1085	5	4.5	4.5
4025	Male	127	168	182	55	14	357	1000	643	5	4.5	4
4033	Male	126	143	152	26	9	430	542	112	4	4	3.5
4034	Male	128	169	179	51	10	407	1000	593	4	4	4
4036	Male	132	182	189	57	7	455	1100	645	4	4.5	4.5
4038	Male	132	202	211	79	9	457	1600	1143	4	4.5	4.5
4040**	Male	140	167	177	37	10	493	952	459	4	4	4
4041	Male	119	147	153	34	6	322	648	326	4	4	4.5
4048	Male	135	219	225	90	6	480	1950	1470	5	4.5	4.5
4053	Male	150	165	171	21	6	681	800	119	4	4	4
4055	Male	151	195	212	61	17	602	1600	998	4	4	4

* = did not record data, still in burrow

** = found transmitter only October 14, 2019

On average, the surviving 24 translocated juvenile desert tortoises increased 49 mm in MCL and 631 grams (g) in weight (without transmitters) from fall 2012 to fall 2019. Results from a two-tailed t-test showed there was no significant difference ($\alpha = 0.05$) in MCL growth between females (43 mm) and males (52 mm) ($p = 0.31$) or in weight gain between females (525 g) and males (677 g) ($p = 0.34$). Average growth in MCL from spring 2019 to fall 2019 was 10 mm with no significant difference between females (11 mm) and males (10 mm) ($p = 0.57$). An analysis of annual growth revealed a strong correlation ($r = 0.91$) between October to March precipitation and growth in MCL. The most growth occurred in years when October to March precipitation was greater than 116 mm. Body condition scores indicated all tortoises were in good condition in 2019, except for Male 4033 which was under condition at 3.5 during the fall assessment.

The main factor for survival appears to be gender with higher survival of males than females. This has been observed by other researchers as well (Melia Nafus, ICR, 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 impossible 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 these canids appear to be the main predators predating study animals. To better understand the predator community and visitation frequency, a camera trap was set up at Site 2 for 140 days from March to August, 2017; 318 days between January and December, 2018; and 239 days between May and December, 2019 for a total of 697 days. Results showed 8 coyote images which is about one every 87 days, 9 kit fox images which is about one every 77 days, 8 badger (*Taxidea taxus*) images which is about one every 87 days, and 4 bobcat (*Lynx rufus*) images which is about one every 174 days.

Why canid predation is higher on females than males is a question yet to be answered. Coyotes and kit foxes use olfaction as one of their dominant senses, therefore it is possible that females are giving off scent that makes them easier to detect. Another possibility is females spend more time aboveground or travel farther, thus making them more susceptible to predation. An analysis conducted on March to October observations from 2012-2017 showed that females actually spend more time in their burrows ($p = 0.01$) and less time in the open ($p = 0.02$) than males and that females and males travel similar distances ($p = 0.76$).

In order to help better understand the interaction between tortoises and their predators, oral, cloacal, and chin/forelimb swabs were collected from all 27 juvenile tortoises and 27 adult tortoises from the road study (10 females, 16 males, 1 unknown) during fall 2015. Additional samples were taken from 26 juveniles (18 males, 8 females) and 12 adults (9 males, 2 females, 1 unknown) during fall 2017. These samples were sent to Dr. Bruce Kimball at the Monell Chemical Senses Center in Philadelphia, Pennsylvania and analyzed using headspace gas chromatography/mass spectrometry to describe chemical signatures and detect any chemical differences between males and females as well as between adults and juveniles that might cause increased canid predation. Results revealed differences between female and male juveniles, primarily in alkyl alcohols.

A preliminary field trial was conducted in September 2018, at the United States Department of Agriculture, Animal and Plant Health Inspection Service, National Wildlife Research Center (USDA-APHIS-NWRC), Millville Predator Research Facility in collaboration with Dr. Eric Gese (USDA-APHIS NWRC) and Dr. Kimball. Synthesized female and male tortoise scent and a

control were presented to captive coyotes to determine if they showed any preference. Initial results showed no preference for the female, male, or control scent. Dr. Kimball refined the scent in 2019 to better accentuate the differences between males and females, and another trial at the Millville facility was conducted in September 2019. Similar to 2018, the captive coyotes showed no preference for the female, male, or control scent. These coyotes were naïve to desert tortoises having never encountered one, so a field trial at the NNSS was conducted in tortoise habitat, assuming that coyotes and kit foxes in this area had encountered desert tortoises. The study was conducted in late October/early November. Paired stations with female scent and male scent randomly placed on opposite sides of a dirt road were set up at 15 locations, spaced about 500 meters apart. A 1-m^2 area was cleared so animal tracks would be visible in the dirt, and the scent was placed in the middle of this cleared area. Sites were checked daily for 9 days (except for one two-day check) from October 30 to November 7. During each check, cleared areas were checked for canid tracks and then cleared of all tracks. Results showed two kit fox visits to female scent and two visits to male scent. No coyote tracks were detected. Canids did not show a preference for female or male tortoise scent. Data from the synthesized chemical scents and observations from all three trials suggest that although there are chemical differences between female and male juvenile tortoises, this does not account for increased predator attraction or curiosity toward female tortoises and would not, therefore account for increased predation of female tortoises.

MSTS will continue monitoring the remaining juvenile study animals well into adulthood with adjustments to the monitoring schedule based on the animals' movement activities. Data analysis and publications will be a joint effort between NNSA/NFO and ICR.

3.2.3 USGS Rock Valley Study

The United States Geological Survey (USGS) in collaboration with FWS, ICR, and Penn State University completed their epidemiology study in the Rock Valley pens in September 2017. All translocated tortoises were removed from the three pens and transported back to Las Vegas. An MSTS biologist assisted in this effort.

As a result of this study, some mating of translocated individuals occurred and a few juvenile tortoises were observed within the pens. FWS considers these resident tortoises. MSTS biologists conducted full coverage surveys of all three pens to identify recent tortoise sign or live juvenile tortoises inside the pens in 2018. No active burrows, live tortoises, or carcasses were observed. One nonviable tortoise egg was found on the surface under a shrub. No monitoring was conducted in 2019. MSTS biologists will monitor the pens during 2020 in order to determine if live juvenile tortoises are present.

3.2.4 Coordination with Other Biologists and Wildlife Agencies

- In February 2019, an MSTS biologist attended the Desert Tortoise Council's 44th annual meeting and symposium. This meeting was held in Tucson, Arizona and included numerous presentations on desert tortoise biology, ecology, and recovery efforts.

- In May 2019, MSTS biologists conducted a tour of desert tortoise habitat on the NNSS for FWS biologists.

- In May 2019, an MSTS biologist attended the Interagency Consultation for Endangered Species, hosted by FWS at the Desert National Wildlife Refuge Visitor Center in Las Vegas, NV. The training provided an overview of required agency actions to comply with the Endangered Species Act.

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 ecological landform units (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 site 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 reported to occur 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 2019 focused on wildland fire fuels surveys, natural water source monitoring, and constructed water source monitoring, including contaminated sumps.

4.1 VEGETATION SURVEY FOR WILDLAND FIRE HAZARD ASSESSMENT

Wildland fires on the NNSS require considerable financial resources for fire suppression and mitigation. For example, costs for fire suppression on or near the NNSS can cost as much as $198 per ha (Hansen and Ostler 2004). Costs incurred from the Egg Point Fire in August 2002 (121 ha) were well over $1 million to replace 1 mile of burned power poles, and more than $200,000 for soil stabilization and revegetation of the burned area.

4.1.1 Wildland Fires in 2019

From 1978 to 2019, an average of 10.3 wildland fires per year and about 98.0 ha per fire have occurred on the NNSS. Most 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 [*Pinus monophylla/Juniperus osteosperma/Artemisia* spp.] plant communities). These 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).

Two wildland fires were reported on the NNSS in 2019. Both of them occurred on April 29 and both were 0.1 ac in size and were extinguished by NNSS Fire and Rescue personnel or carefully monitored until they burned out.

4.1.2 Fuel Survey Methods

Beginning in 2004, and in response to DOE O 231.1B, surveys were initiated on the NNSS to identify wildland fire hazards. Vegetation surveys were conducted between April 24 and June 11, 2019, at sites located along and adjacent to major NNSS corridors to estimate the abundance of fuels produced by native and invasive 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) 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.

4.1.3 Fuel Survey Results

4.1.3.1 Climate

There were 17 rain gauges on the NNSS (Hansen and Ostler 2004) that were used historically to measure precipitation. Data from these weather station gauges extends back more than 30 years (National Oceanic and Atmospheric Administration [NOAA] 2013). 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 NOAA via telecommunications, rather than manually retrieving and processing the data (D. J. Hansen, personal communication, May 4, 2012). 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 2019 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.

In order 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 is correlated ($R = 0.77$) with our estimations of the combined fuel loads. During 2019, the average precipitation from the remaining 14 rain gauge stations on the NNSS during December–April was 192.6 mm, which is well above the average amount of 104.6 mm received on the NNSS. In fact, this was the second wettest period recorded since monitoring began in 2004, and only slightly lower than 200.0 mm recorded in 2004-05 (Figure 4-1).

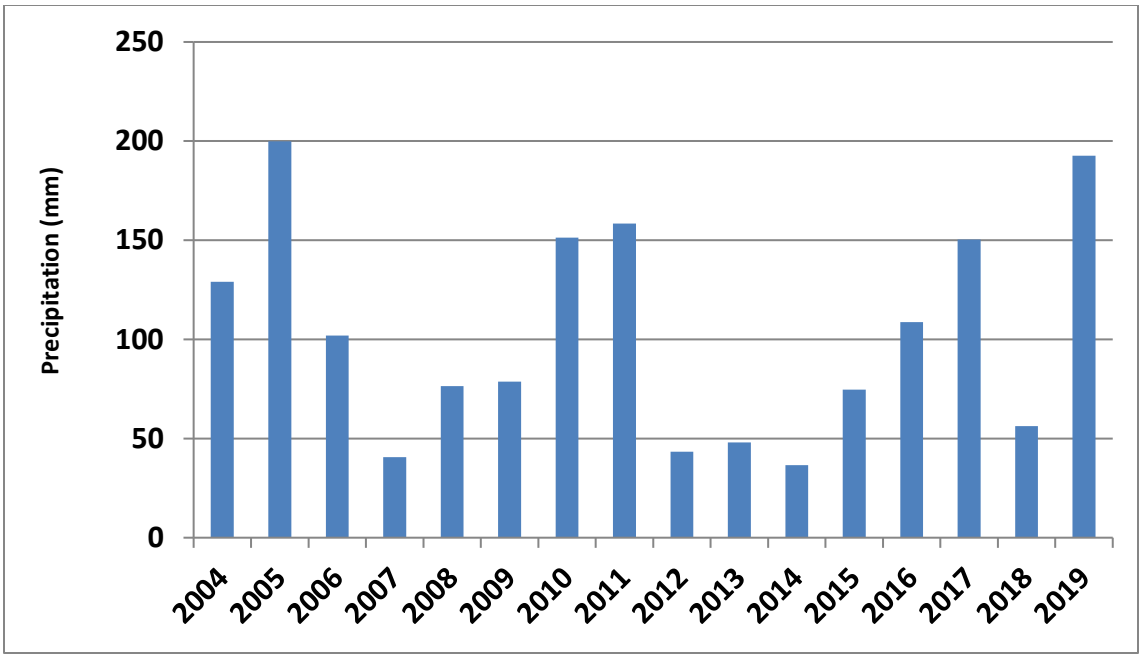

Figure 4-1. Average precipitation from December (previous year) through April for the years 2004 through 2019.

4.1.3.2 Fuels

Due to the above-average precipitation received during winter/spring 2018-19, production of annual forbs and grasses was high. Production of perennial herbaceous grasses and forbs was also high.

The fine fuels index increased in 2019 (2.41) compared to 2018 (1.83), and was the fifth highest recorded since 2004 (Table 4-1). Most of the fine fuels were from annual forbs rather than invasive annual grasses such as red brome (*Bromus rubens*) and cheatgrass (*Bromus tectorum*). Although these species were present and dominated previously burned areas; natural, unburned-areas had relatively low red brome and cheatgrass production even though precipitation was so high. It was a cool, wet spring which favors annual forb production rather than red brome and cheatgrass production.

The woody fuels index value was slightly higher in 2019 (2.59) than in 2018 (2.49) (Table 4-1). This was an average value in comparison to the other index values since 2004.

The combined index values (fine fuels plus woody fuels) for 2019 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 for 2019 was 5.00, which was the fifth highest value recorded since 2004 (Table 4-1), suggesting above-normal fuels for the NNSS.

The locations and results of the fine fuels, woody fuels and combined fuels surveys at 104 stations on the NNSS inspected during 2019 are shown in Figures 4-2, 4-3 and 4-4, respectively. The highest combined index values and thus the highest potential for wildland fires occurred in Fortymile Canyon, Mid Valley and southern Yucca Flat. High amounts of fine fuels were found in Fortymile Canyon, Yucca Flat, and Mid Valley. High amounts of woody fuels were primarily

Table 4-1. Woody fuels, fine fuels and combined fuels index values for 2004–2019

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

found in the forested portions of Pahute Mesa, but also occurred along Stockade Wash Road, Buckboard Mesa Road, north Mid Valley Road, Cane Spring Road, upper Fortymile Canyon, and southern Yucca Flat.

Photographs were taken from permanent locations for all 104 sites during the past 14 years. Figure 4-5 shows photographs of Site 99 in Yucca Flat for the years 2016, 2017, 2018, and 2019. 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.

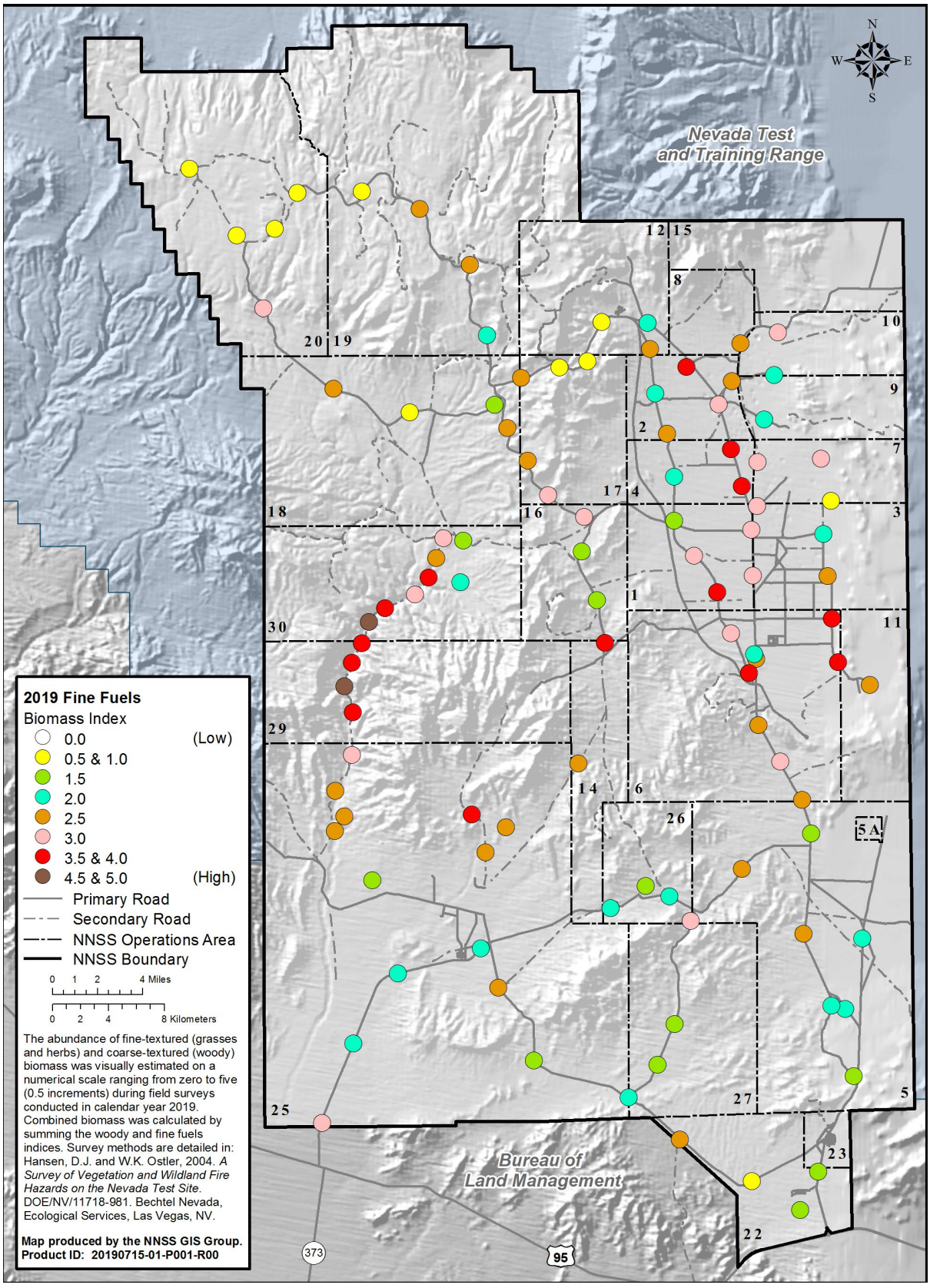

Figure 4-2. Index of fine fuels for 104 survey stations on the NNSS during 2019.

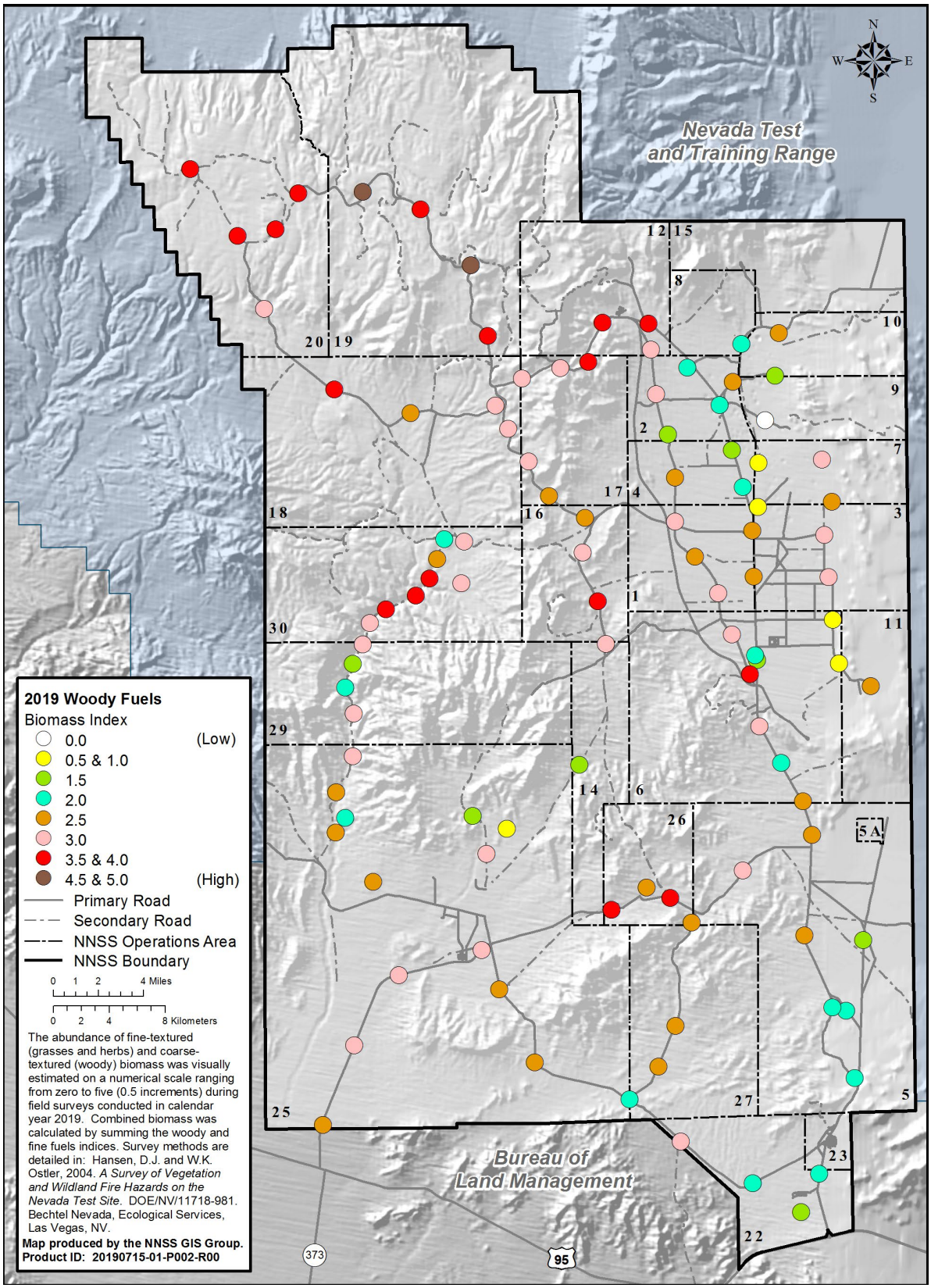

Figure 4-3. Index of woody fuels for 104 survey stations on the NNSS during 2019.

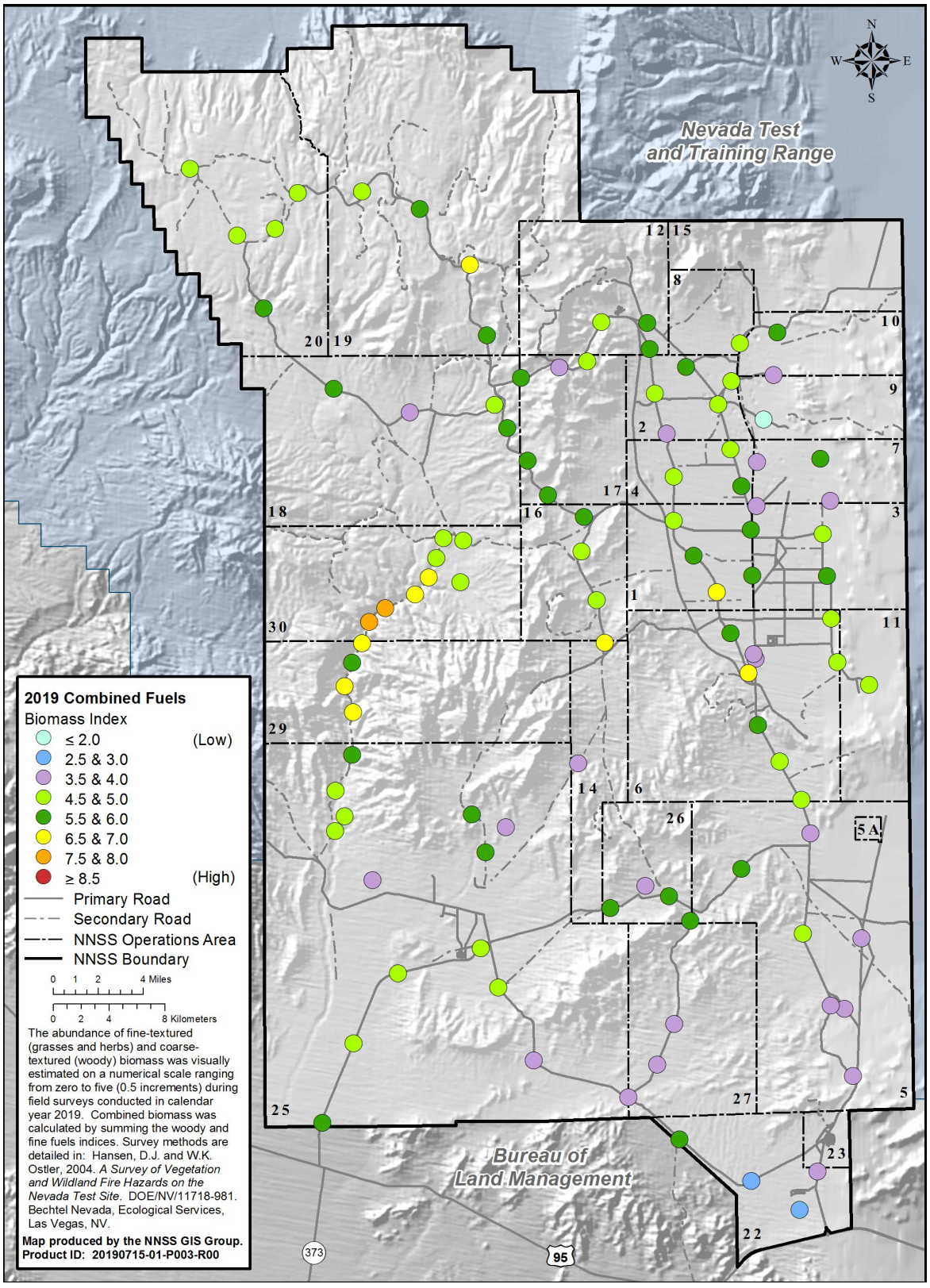

Figure 4-4. Index of combined fine fuels and woody fuels for 104 survey stations on the NNSS during 2019.

Figure 4-5. Site 99 on the west side of Yucca Flat in 2016, 2017, 2018, and 2019.

(Photos by W. K. Ostler, April 20, 2016 [top left] and by J. Perry, April 26, 2017 [top right], April 24, 2018 [bottom left], and May 14, 2019 [bottom right]).

4.1.4 Invasive Plants

The three most commonly observed invasive annual plants to colonize the NNSS are Arabian schismus, found at low elevations; red brome, found at low to moderate elevations; and cheatgrass, found at middle to high elevations (Table 4-2).

Cheatgrass was the most common invasive plant occurring on 79% of the study sites. While it was predominantly found at middle to higher elevations it was found at lower elevation sites as well. Red brome (67%) and redstem stork's bill (50%) were found on at least half of the sites sampled. Precipitation history (Figure 4-1, shown previously) 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 responses of some species, both invasive and native species, suggest 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. Red brome and cheatgrass for example were found at 67% and 79% of sites sampled, respectively, but did not account for a majority of the biomass at many sites. Rather, conditions were more conducive to native annual forb germination and biomass production. Cool, wet springs appear to favor native annual forbs over red brome and cheatgrass, especially in unburned areas.

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 are more closely spaced than native vegetation. 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. 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 hazards of residual fuels contributing to wildland fires were above average for 2019 and presented a wildland fire risk. However, because of the cool, wet spring soil moisture remained high and vegetation did not dry out until mid-June, thus shortening the wildland fire season by more than a month. Once ignited, high ambient temperatures and high winds contribute to the spread of fire in areas where the abundance of fuels is sufficient to carry the flames of the fire. This is particularly acute in areas such as Fortymile Canyon and Mid Valley that have burned previously and now consist of almost pure stands of cheatgrass and/or red brome. Rapid response by NNSS Fire and Rescue after fires are ignited is a key factor in minimizing wildland fire spread and severity.

Table 4-2. Precipitation history and percent presence of key plant species contributing to fine fuels at surveyed sites

Precipitation History	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Mean Precipitation (mm) (December–April)	129.0	199.9	101.9	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
Invasive Introduced Species																
Bromus rubens (red brome)	51.7	64.4	67.8	0	63.0	63.2	58.5	62.3	0	19.2	28.8	52.9	54.8	68.3	43.3	67.3
Bromus tectorum (cheatgrass)	40.3	54.0	60.7	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
Erodium cicutarium (redstem stork's bill)	5.2	6.2	24.6	0	21.3	27.4	33.0	42.4	0.9	37.5	33.7	25.0	43.3	47.1	46.2	50
Schismus arabicus (Arabian schismus)	4.7	2.8	5.2	0	11.4	9.4	3.8	11.3	0	9.6	6.7	10.6	15.4	15.4	21.1	18.3
Native Species																
Amsinckia tessellata (bristly fiddleneck)	34.0	62.0	16.1	0	63.0	48.1	67.9	63.2	1.8	41.3	26.0	47.1	66.4	54.8	50	65.4
Mentzelia albicaulis (whitestem blazingstar)	49.8	8.1	0	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
Chaenactis fremontii (pincushion flower)	27.0	8.0	0	0	1.4	11.3	13.2	0.5	0	6.7	2.9	7.7	32.7	38.5	12.5	28.8

4.2 REPTILE STUDIES

No formal trapping or roadkill studies took place in 2019. 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.

One night snake (*Hypsiglena torquata*) was found on a project site in Mercury and moved a safe distance away from the project. One ground snake (*Sonora semiannulata*) was found on a glue trap in a building in Mercury. It was extracted and released back into the desert.

4.3 NATURAL WATER SOURCE MONITORING

Nine natural water sources (six springs, three rock tanks) were monitored with motion-activated cameras in 2019, primarily to document the presence of mountain lions (*Puma concolor*) and other wildlife (Figure 4-6). Results are found in Table 6-5 (see Section 6.7.1, 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 2019, Topopah Spring was nearly dry with just a small wet spot in the cave pool. Vegetation was heavily trampled primarily by burros (*Equus asinus*) and mule deer (*Odocoileus hemionus*) at Twin Spring with numerous new burro trails on the slope leading to the spring. There was also a small perennial pool of standing water. Vegetation at Captain Jack Spring was pretty dense in the absence of feral horses using the perennial spring, and cattails (*Typha domingensis*) were very dense around Cane Spring.

Twin Spring had the most images (4,280; 6 mammals, 7 birds) which is astounding given that the camera was only operational for about 40 days in mid-May/early June and the first half of November. Only 30 images of mourning doves (*Zenaida macroura*) and 1 image of chukar (*Alectoris chukar*) were taken in May/early June with all other images taken in November. Mule deer and burros were photographed the most with 1,386 and 1,375 images taken, respectively; while 1,274 images of chukar were recorded. Several desert bighorn sheep (*Ovis canadensis nelsoni*) rams (107 images) and a flock of pinyon jays (*Gymnorhinus cyanocephalus*) (41 images) were also recorded.

Delirium Canyon Tanks (#5) had the highest species richness with 10 mammal and seven bird species detected in 2,753 images. Mourning doves (1,677 images) and desert bighorn sheep (820 images) were the most photographed species. Noteworthy species detected include ring-tailed cat (*Bassariscus astutus*), spotted skunk (*Spilogale gracilis*), cliff chipmunk (*Tamias dorsalis*), bats, and indigo bunting (*Passerina cyanea*) (Figure 4-7).

Six mammals, five birds, and one reptile were photographed at Cottonwood Spring. A total of 2,108 images were taken dominated by 1,581 images of house finches (*Haemorhous mexicanus*) and 365 images of desert bighorn sheep. Noteworthy observations were bats and loggerhead shrike (*Lanius ludovicianus*). A total of 1,228 images of five mammals and five birds were documented at Captain Jack Spring (#12). Mule deer dominated with 1,166 images recorded.

Gold Meadows Spring (#18) had 251 images of six mammal and three bird species. Most of these were horses (75) and mule deer (72). Six images of Rocky Mountain elk (*Cervus elaphus*) were also detected.

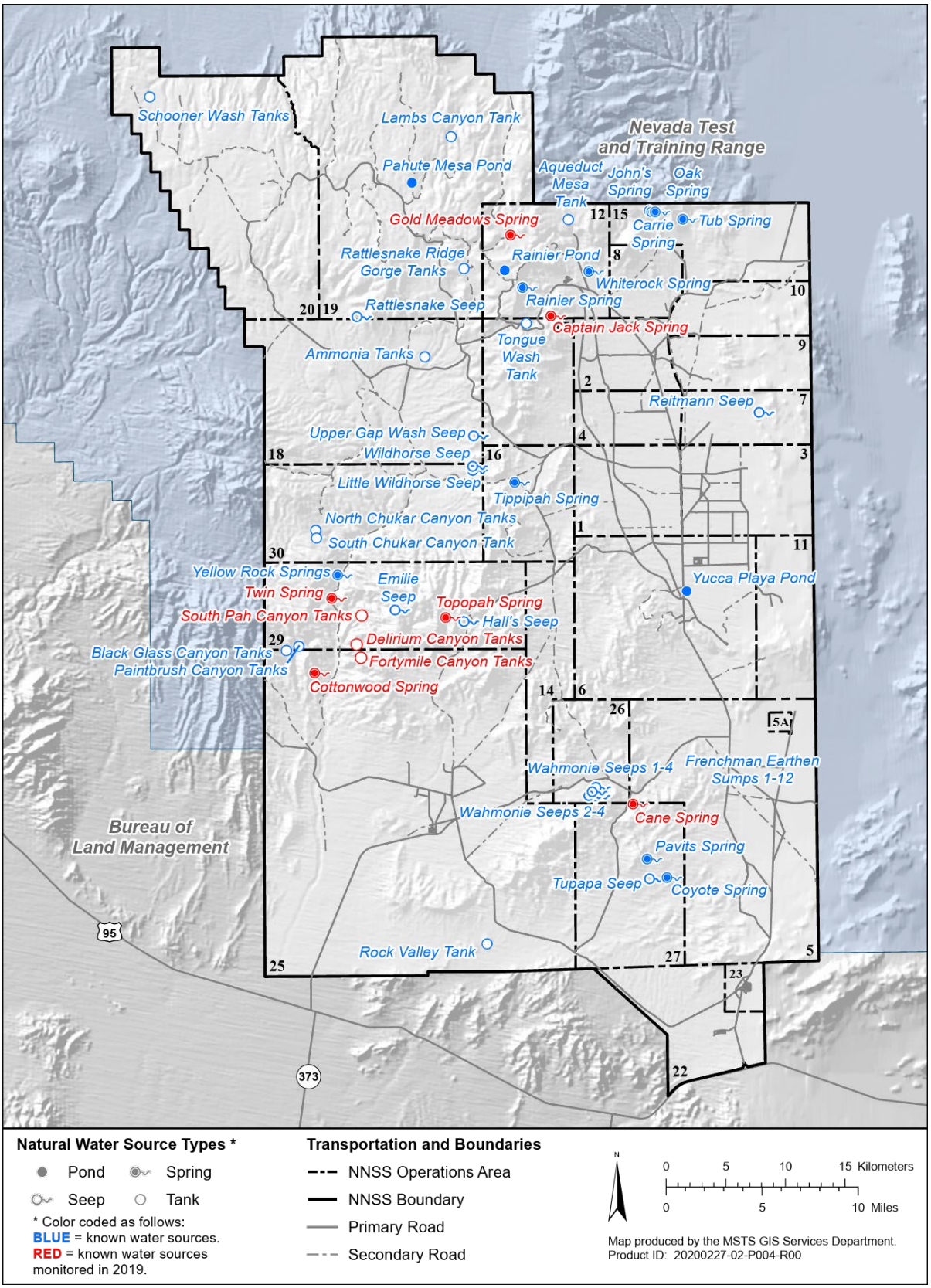

Figure 4-6. Natural water sources on the NNSS, including those monitored in 2019.

Figure 4-7. Indigo bunting and mourning doves at Delirium Canyon Tanks (#5).

(Photo by motion-activated camera, June 29, 2019)

Figure 4-8. Male pronghorn antelope at Topopah Spring (#9).

(Photo by motion-activated camera, August 27, 2019)

At South Pah Canyon Tanks (#15), one mammal and two bird species were detected in 190 images with 178 images of mourning doves. At Fortymile Canyon Tanks four mammal and two bird species were detected in 74 images with 46 images of desert bighorn sheep. Only 34 images of five mammal species were recorded at Topopah Spring including the first record of pronghorn antelope (*Antilocapra americana*) using this spring (Figure 4-8). A mature buck was photographed at 2252 hours on August 27. Only seven images of mule deer were recorded at Cane Spring but the camera was only operational between September 10 and December 17.

4.4 CONSTRUCTED WATER SOURCE MONITORING

Nine constructed water sources were monitored with motion-activated cameras to document the presence of mountain lions and other wildlife during 2019. These included one well pond (Camp 17 Pond), five water troughs installed to mitigate the loss of well ponds, and three radiologically-contaminated sumps (Figure 4-9).

Camp 17 Pond (#6) had the greatest species richness of any of the cameras in operation during 2019 with 23 species (6 mammal, 17 bird) being photographed in 2,946 images (Table 6-5). Mule deer (1,573 images), common raven (430 images), and feral horses (*Equus caballus*) (338 images) were the dominant species. Noteworthy observations include white-faced ibis (*Plegadis chihi*) (1 image) (Figure 4-10), black-necked stilt (*Himantopus mexicanus*) (10 images), and belted kingfisher (*Megaceryle alcyon*) (5 images).

4.4.1 Mitigating Water Loss for Wildlife

Water conservation measures were implemented on the NNSS in 2012 at four sites: Area 6 Construction Yard (Area 6 Los Alamos National Laboratory [LANL] Pond), Well C1 Pond, Well 5B Pond, and J11 Pond. In order 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 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 2019 are included in Table 6-5 (see Section 6.7.1, Motion-Activated Cameras).

Wildlife use at Well 5C trough (#24) was very heavy with the most images of all cameras on the NNSS this year (5,781 images) with at least 16 species (6 mammals and 10 birds) photographed. Mourning doves dominated with 3,765 images followed by pronghorn antelope (726 images), burros (630 images), and common ravens (368 images). Noteworthy observations include loggerhead shrike (5 images) (Figure 4-11), greater roadrunner (*Geococcyx californianus*), and yellow-headed blackbird (*Xanthocephalus xanthocephalus*).

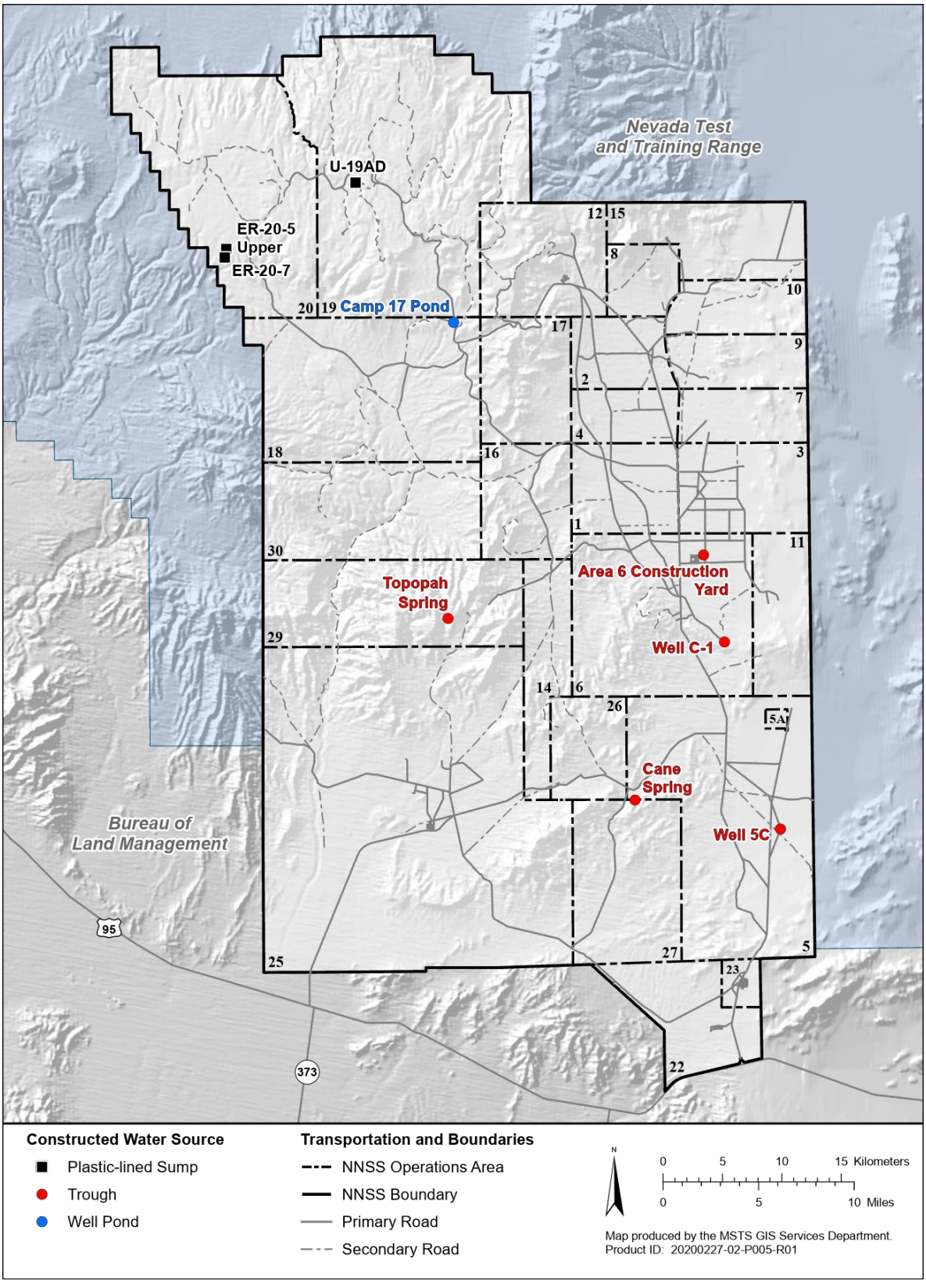

Figure 4-9. Constructed water sources monitored with motion-activated cameras for wildlife use during 2019.

Figure 4-10. White-faced ibis at Camp 17 Pond (#6).

(Photo by motion-activated camera, September 14, 2019)

Figure 4-11. Loggerhead shrike at Well 5C Trough (#24).

(Photo taken by motion-activated camera, December 10, 2019)

Wildlife use at the Well C1 Pond Trough (#10) was moderate (304 images) with five mammal and four bird species detected. Burros (99 images) and mourning doves (95 images) were the most common species photographed. Use at the other three troughs was light with 19 images of mule deer at Topopah Spring Trough (#23), 17 images of one mammal and two bird species (mourning dove [12 images], common raven [4 images], and mule deer [1 image]) at Cane Spring Trough (#8), and eight images of one mammal and two bird species at Area 6 LANL Pond trough (#14) (pronghorn antelope [5 images], mourning dove [2 images], and turkey vulture [*Cathartes aura*] [1 image]).

The number of animal photographs taken at Topopah Spring (n = 34) and the trough (n = 19) were similar but species richness was greater at the spring (n = 5) than at the trough (n = 1). A similar pattern is evident at Cane Spring comparing use from September 10 to December 17 when both cameras were working with seven images of mule deer taken at the spring and zero images taken at the trough. This difference may be due to a preference of some species for the natural setting of the spring, water availability and accessibility, or a combination of both.

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.

4.4.2 Monitoring Wildlife Use at Potentially Contaminated Water Sources

During 2019, motion-activated cameras were set up at three contaminated water sources which are sumps constructed to retain groundwater and drilling fluids from Underground Test Area (UGTA) wells during drilling, well development, and groundwater testing. The sumps included those located at UGTA wells ER 20-7 (#13), ER 20-5 Upper (#2), and U19ad (#25) (Figure 4-9). The cameras were also added to the network of cameras used for mountain lion monitoring (see Section 6.7.1, Motion-Activated Cameras) (Table 6-5). Typically, discharge water and drilling fluids having ≥400,000 picocuries/liter (pCi/L) 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 cameras were set up to document which wildlife species were using the sumps 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.

Overall, wildlife use at the contaminated sumps was light with ER 20-7 (#13) having the most use with 16 images of four bird species recorded. Common ravens were the most common (11 images). Chukar, mourning doves, and a Say's phoebe (*Sayornis saya*) were also detected at the sump. ER 20-5 Upper (#2) only had six images of passerine birds documented, and U19ad (#25) only had one image of an unidentified bird.

A motion-activated camera was also set at E Tunnel Ponds, a perennial source of contaminated water flowing from E Tunnel, as part of another project (Ron Warren, personal communication). Mule deer (123 photos), elk (52 photos), mountain lions (11 photos), golden eagles (9 photos), bobcat (1 photo), coyote (1 photo) and numerous photos of other bird species, including mourning doves and chukar, were documented.

Important species are using these sites and are potentially up-taking radiological contaminants. Hunt-able species such as chukar and mourning doves are a potential pathway of exposure to the general public. Protected birds such as golden eagles, common ravens, Say's phoebes and most passerines 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 2019) available at https://www.nnss.gov/docs/docs_LibraryPublications/2018%20Nevada%20National%20Security%20Site%20Environmental%20Report.pdf.

4.5 COORDINATION WITH SCIENTISTS AND ECOSYSTEM MANAGEMENT AGENCIES

Site biologists interfaced with other scientists and ecosystem management agencies in 2019 for the following activities:

- Upon NNSA/NFO request, gave presentation about NNSS wildlife at the Consolidated Group of Tribes and Organizations annual meeting in April. Provided them with numerous photos of wildlife from Captain Jack Spring.
- Accompanied U.S. Forest Service personnel in November and took photos of their plots for the Interior West Forest Inventory and Analysis Program.
- Participated in multiple conference calls for the Mojave Seeds of Success Program and collected several samples of Indian ricegrass (*Stipa hymenoides*) and yellow cups from around the NNSS for genetic testing.
- Participated in multiple conference calls for the DOE Invasive and Endangered Species Working Group.
- Collaborated with Dr. Lee Dyer and Dr. Matt Forister (University of Nevada Reno) to develop and submit a Site Directed Research and Development proposal entitled "Measuring radionuclide-induced metabolomic and genomic shifts in plants to detect nuclear weapons testing and characterize past nuclear events." Collected silvery lupine (*Lupinus argenteus*) and freckled milkvetch (*Astragalus lentiginosus*) samples for genomic testing.
- Collaborated with Sasha Reed (U.S. Geological Survey) and others to establish a study site on the NNSS for a Strategic Environmental Research and Development Program funded project entitled "Forecasting Dryland Ecosystem Vulnerability to Climate Change: A Cross-Systems Assessment of Vegetation and Process Responses to Disturbance and Climate Variability on DoD/DOE Lands."
- Gave biologists from Southern Nevada Water Authority an ecological tour of the NNSS in December.

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. Taxonomy in the field of botany is constantly changing based on new information obtained on the relationship of plant species. In order to track these changes, MSTS biologists reviewed several widely accepted sources: *The Jepson Manual: Higher Plants of California* (Baldwin et al. 2012), the NNHP, the NNPS, and the U.S. Department of Agriculture (USDA) PLANTS database (USDA, 2020), as well as attending meetings and workshops with other local botanists.

The working list of over 850 plant species identified on the NNSS was reviewed with the 2020 NNHP At-Risk Plant and Animal Tracking List (NNHP List) to determine if any updates are needed to the NNSS sensitive plant monitoring program. Four plants currently not listed on the NNSS sensitive plant monitoring program, but listed on the NNHP List will be evaluated to determine their NNSS sensitive plant species ranking, if warranted: Clokey's cryptantha (*Cryptantha clokeyi*), Lahontan beardtongue (*Penstemon palmeri var. macranthus*), Nye milkvetch (*Astragalus nyensis*), and sand cholla (*Grusonia pulchella* formerly *Opuntia pulchella*). The Joshua tree (*Yucca brevifolia*), which was under evaluation in 2019, will be removed from the evaluation list and not added to the NNSS sensitive plant monitoring program based on updated information provided by FWS.

A review of past monitoring surveys, known and historical populations, and the database of the sensitive plant species on the NNSS began in 2019. The NNSS's Adaptive Management Plan for Sensitive Species on the Nevada Test Site (Bechtel Nevada 2001) and MSTS's Organization Procedure titled *Monitoring Sensitive Plant Species* lay out monitoring, management and goals for sensitive plant protection. These procedures include maintaining updated data, maps, and fact sheets on each plant. This updated information for each plant will be completed in 2020 and include the following: known population locations and size on the NNSS, range wide distribution, herbarium collections, monitoring surveys, known habitat, known threats and photos.

5.1 SPECIES EVALUATIONS

5.1.1 Clokey's cryptantha (*Cryptantha clokeyi*)

Clokey's cryptantha was added to the NNHP List in January 2019. Previously known to be endemic to California, this species was found in Nevada in 2016 in Perlite Canyon, just east of Beatty. The species was possibly found on the NNSS in 40-Mile Canyon near ledges located in the general area of 555466mE, 4087150mN (UTM NAD83). This area was searched in May 2019, just after its bloom period in April. One specimen was collected at the base of a rock face and analyzed under a microscope. Based on Simpson and Hasenstab (2009), the nutlets and branching structure of the specimen matched a more similar species, Nevada cryptantha (*Cryptantha nevadensis*).

Clokey's cryptantha was discussed during the Nevada Rare Plant Workshop hosted by the Nevada Native Plant Society in October 2019. Few attendees were familiar with the plant but it was noted that the plant grows on steep slopes, alongside several similar Cryptantha species, making it difficult to identify in the field. It is recommended that the off site location in Perlite Canyon be visited during the bloom period to aide in identifying potential habitat and comparisons to other Cryptantha annuals.

Without confirmation that Clokey's cryptantha occurs on the NNSS, it will not be added to the NNSS sensitive plant monitoring list. Occurrences on and off the NNSS will continue to be evaluated to determine if the plant does grow on the NNSS.

5.1.2 Joshua tree (*Yucca brevifolia*)

The Joshua tree (*Yucca brevifolia* and *Y. jaegeriana*) was petitioned in 2015 to be listed under the Endangered Species Act (ESA). This petition was reconsidered in 2018 and evaluated by FWS. On August 14, 2019 the Carlsbad Fish and Wildlife Service Office released their findings that the Joshua tree does not require protection under the ESA with the following statement:

"Most habitat occupied by the two species is federally-managed by agencies including the National Park Service, Bureau of Land Management, U.S. Forest Service and Department of Defense. A much smaller portion of habitat is managed by state or local governments or is privately owned. Species distribution mapping shows there has been no major reduction or contraction in Joshua tree populations during the last 40 years. Additionally, several federal agencies, the states of California and Arizona and several local jurisdictions have adopted and implemented policies that provide some protections to Joshua trees from harvesting and removal" (FWS 2019-1).

The evaluation by FWS was discussed during the Nevada Rare Plant Workshop hosted by the Nevada Native Plant Society in October 2019. It was suggested the southern range of the Joshua tree in California, namely Joshua Tree National Park, is where population declines have been documented and warrants further research. With the NNSS located within the northern distribution range and the continued efforts of MSTS biologists to recommend construction projects avoid Joshua trees, *Y. brevifolia* will not be included in the NNSS sensitive plant monitoring plan, but will remain as a protected/regulated species (Table 2-1).

5.1.3 Lahontan beardtongue (*Penstemon palmeri* var. *macranthus*)

There are three varieties of Palmer's penstemon (*Penstemon palmeri*) found in the western United States: scented beardtongue (*P. palmeri* variety [var.] *eglandulosus*), Palmer's penstemon (*P. palmeri* var. *palmeri*) and Lahontan beardtongue. Scented beardtongue is not found in Nevada while the other two do occur in Nevada and are very similar and overlap in distribution. A key to the three varieties can be found in Cronquist et al. (1984).

Lahontan beardtongue is a Nevada endemic perennial subshrub with large, pale lavender tubular flowers. It is listed on the NNHP List and has been found in Churchill, Nye, Pershing, and White Pine counties in Nevada. Palmer's penstemon is wide spread throughout the western United States from lower to upper elevations and is not considered an at-risk, rare or sensitive plant. Lahontan beardtongue is distinguished from Palmer's penstemon by its longer corolla tube (cylindrical, hollow base of flower) and its often sessile upper leaves (not fused surrounding the stem).

Palmer's penstemon has been documented and collected on the NNSS, but the variety has not been distinguished as Palmer's penstemon or Lahontan beardtongue. There are 11 herbarium specimens collected from the NNSS; nine are housed at the NNSS herbarium and two at the Wesley E. Niles Herbarium at the University of Nevada, Las Vegas. Collection dates range from 1959 through 1978, which make most of the specimens difficult to use for identification. One herbarium specimen collected by J.C. Beatley on April 26, 1959 "growing 1-2 miles west of Camp Mercury" shows the characteristic leaves of Lahontan beardtongue.

Palmer's penstemon occurrences were recorded during ELU surveys from 1996 through 1998. It was observed in eight different ELUs, but the variety was not identified. Occurrences were documented throughout the NNSS at lower, mid and upper elevations (NNSS Operational Areas 19, 22, 26, 27 and 29; refer to Figure 2-1 for Operational Areas).

Based on the locations and habitat descriptions of the known occurrences of Palmer's penstemon on the NNSS, it is possible both varieties grow on the NNSS. It is recommended that known locations be visited during the plant's bloom period (May through July) to determine taxonomy. Specimens should be collected, pressed and accessioned into the NNSS herbarium. If needed, specimens shall be sent to a specialist for identification. Without confirmation that Lahontan beardtongue occurs on the NNSS, it will not be added to the NNSS sensitive plant monitoring list. Occurrences on the NNSS will continue to be evaluated to determine if the plant does grow on the NNSS.

5.1.4 Nye milkvetch (*Astragalus nyensis*)

Nye milkvetch is a small, herbaceous annual thought to be extirpated from southern Frenchman Flat in Area 5 by construction activities (Beatley 1977). The plant is listed on the NNHP List and is found in Clark, Lincoln, and Nye counties in Nevada. The species has also been documented in eastern California, southwestern Utah and northwestern Arizona. The plant was first identified and collected in 1941 in southern Frenchman Flat on the NNSS. Up until 1978, the plant was thought to be extirpated from the NNSS with the assumption that development of several gravel pits disturbed the type locality population (Rhoads and Williams 1977, Rhoads et al. 1979). Surveys conducted in April and May in 1978 by EG&G Energy Measurements Group found Nye milkvetch in two areas of southern Frenchman Flat, one of which was at the existing gravel pits (Figure 5-1). These findings were reported in January 1979 in an addendum to a report published in 1977 (Rhoads and Williams 1977, Rhoads et al. 1979). One survey data form from May 1995 stated, "some Nye milkvetch plants" were found during a survey for a different sensitive plant species, Parish's phacelia (*Phacelia parishii*), at the same gravel pits (Figure 5-1). This was the last documented survey for Nye milkvetch that could be found on the NNSS.

There are no specimen collections of Nye milkvetch in the NNSS herbarium. Several collections were made during the 1978 surveys and are housed at the New York Botanical Garden herbarium. Collection information can be obtained from the Intermountain Region Herbarium Network website (http://intermountainbiota.org/portal/index.php).

There is a specimen in the NNSS herbarium, collected by J.C. Beatley in 1964, originally described as *A. acutirostris* which was later annotated by Barneby as *A. nyensis*. It was then re-described by Beatley as *A. didymocarpus* var. *dispermus* (Rhoads et al. 1977). Nye milkvetch is closely related to several similar species, which can make it easily overlooked in the field. Careful attention is needed to distinguish it from *A. didymocarpus* var. *dispermus*, *A. acutirostris*, and *A. nuttalianus* var. *imperfectus* (Mozingo and Williams 1980).

The conservation of this species was noted during the Nevada Rare Plant Workshop hosted by the Nevada Native Plant Society in October 2019. It was discussed that the plant is fairly widespread throughout its range but there are less than thirty known locations in Nevada, most found east of the NNSS on Wildlife Refuge Land. In 1995, Nye milkvetch was not considered a sensitive plant by FWS and was not included on the NNSS sensitive plant species list at that time (W.K. Ostler, personal communication, April 2020). With the type locality found on the NNSS and the last observations in 1995, this plant's sensitive plant ranking on the NNSS shall be evaluated by conducting surveys and collecting specimens for identification. If needed, specimens shall be sent to a specialist for identification. Nye milkvetch will be added to the NNSS sensitive plant monitoring list with ranking status as "evaluate". More information is needed to assess the distribution and abundance of this plant on the NNSS.

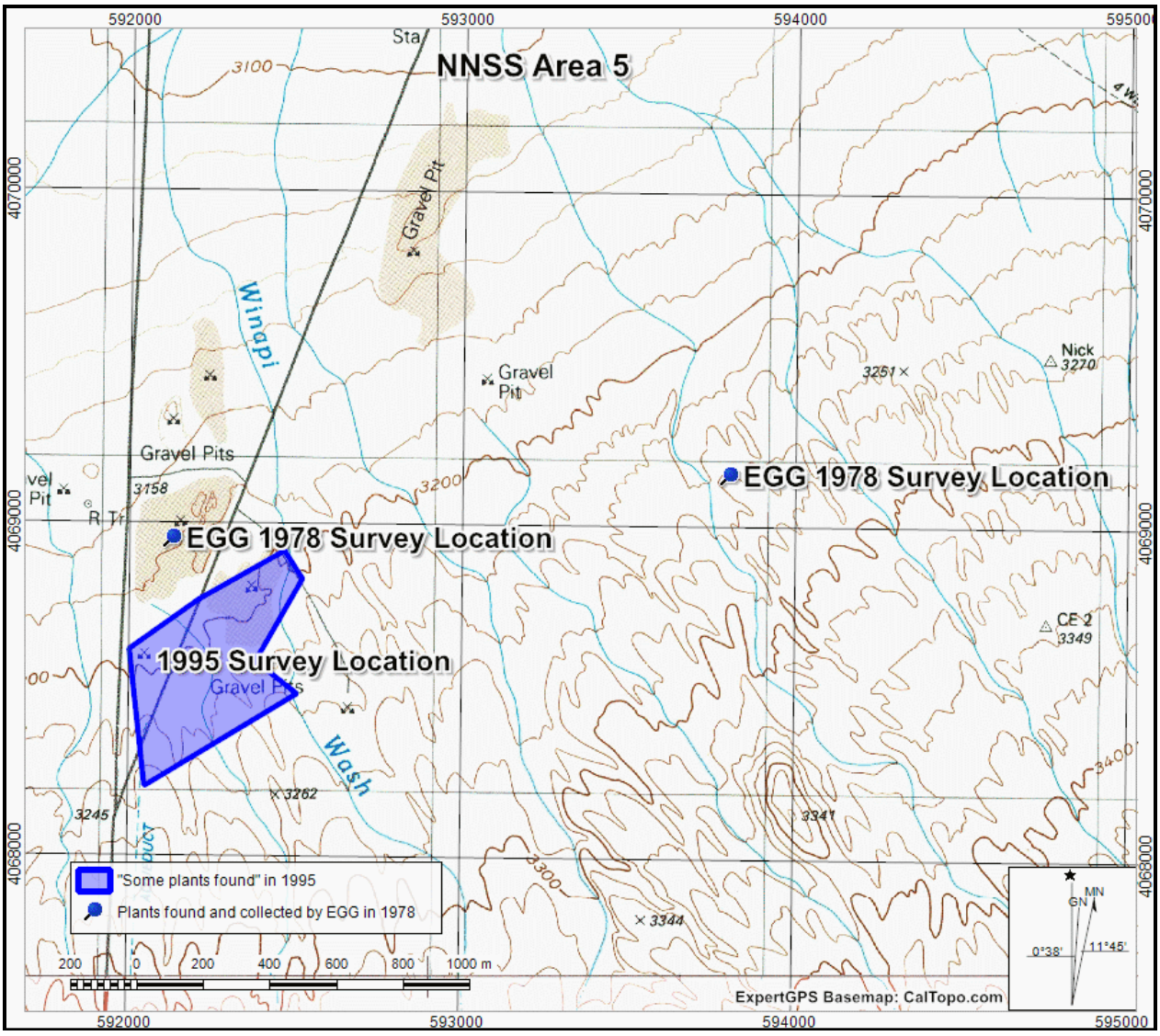

Figure 5-1. Known locations of Nye milkvetch (UTM [Zone 11, meters], NAD83).

5.1.5 Sand Cholla (*Grusonia pulchella*)

Sand cholla is a cactus species on the NNHP List and is known to occur on the NNSS (Figure 5-2). In 2019, evaluation and surveys for this species began to determine if it warrants adding to the NNSS sensitive plant monitoring list. Five known locations were visited in July (Figure 5-3). Although similar cholla cactus species were observed at the locations, sand cholla was not found. Sand cholla is a small cactus, growing less than ten inches tall, and is known to grow under the canopy of other shrubs, making it difficult to see (Poulson 2017). Presence of sand cholla at these locations has not been ruled out and require surveys during its bloom period in June.

At one visited location in Area 6 (Figure 5-3, Location 1), sand cholla was found east of the surveyed area during a pre-activity survey for a construction project. This area is now cleared of vegetation from the construction of a batch plant. A second plant was observed at a project site in Mid Valley in Area 16 during a pre-activity survey (Figure 5-3). If the project proceeds, the area will be cleared of vegetation. If the project will not be able to avoid the plant, biologists recommend an attempted relocation of the plant.

Opportunistic sightings of three sand cholla plants may have been found just off site, west of Area 22 on Bureau of Land Management land (Figure 5-3). Plants were all found in shallow wash bottoms at a slight (1-10%) east facing slope in Creosote-White bursage habitat (*Larrea tridentata-Ambrosia dumosa*) in the open. The locations should be revisited during the bloom period for identification.

Due to the disturbance of the plant's two known locations in 2019, it is recommended that sand cholla continue to be surveyed and its distribution be evaluated to determine its NNSS sensitive plant species ranking. It is recommended that surveys of past known locations be visited during the plant's bloom period in June.

Figure 5-2. Flowering sand cholla growing within another shrub.

(Photo by W.K. Ostler, June 13, 2005)

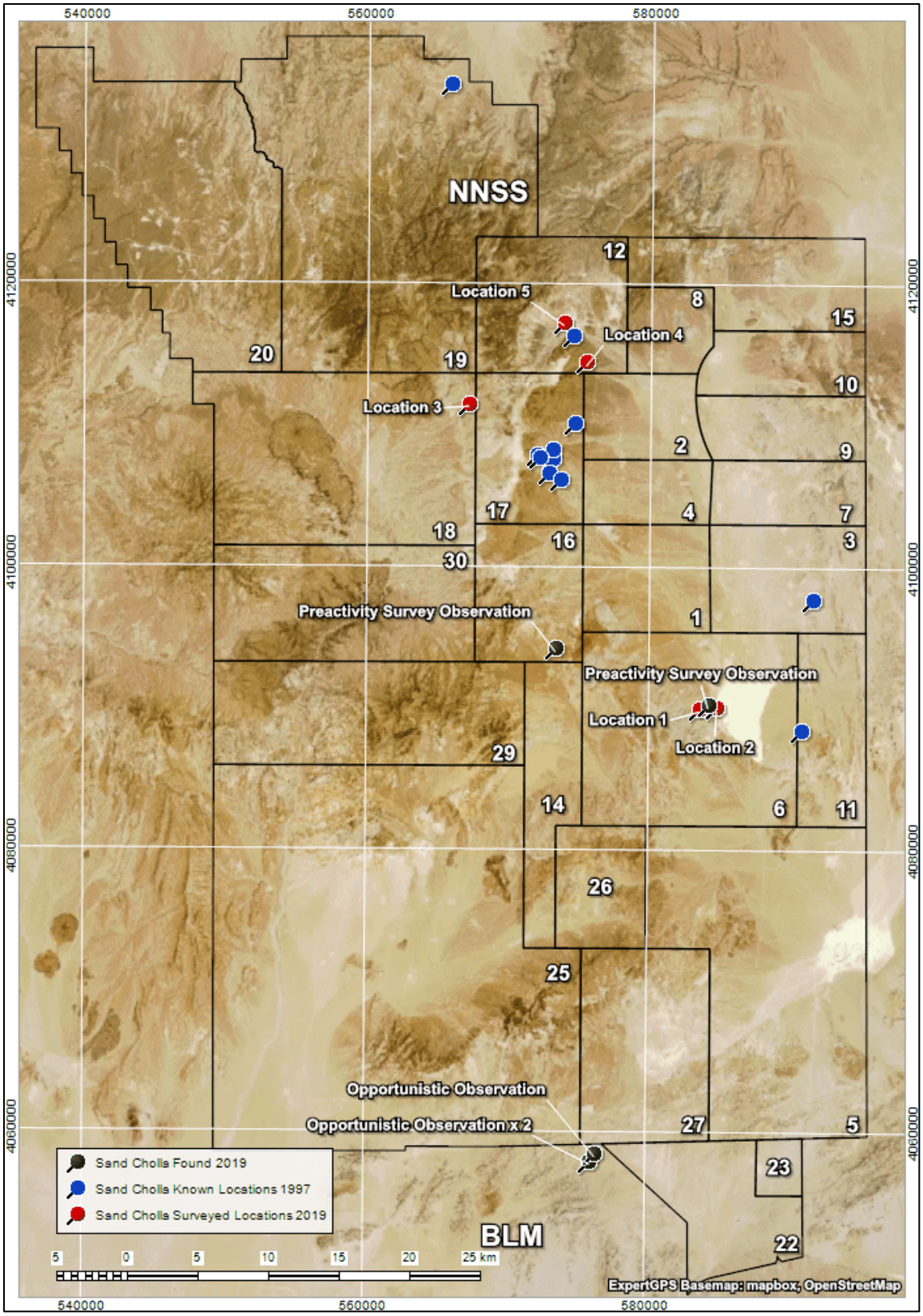

Figure 5-3. Known locations, survey locations and observations of sand cholla on or near the NNSS (UTM [Zone 11, meters], NAD83).

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 to ensure NNSS activities are not impacting the species. Field surveys are conducted to verify previously reported locations, to better define population boundaries, and to identify potential habitat for sensitive plant species known to occur on or adjacent to the NNSS. In 2019, several known plant populations were visited in order to familiarize new MSTS biologists with species identification and determine recent threats, if any, to the populations.

5.2.1 Black woollypod (*Astragalus funereus*)

Black woollypod is a small, low growing milkvetch in the Fabaceae (pea) family (Figure 5-4). It is also known as the Funeral Mountain milkvetch, identified from the Funeral Mountains in Death Valley, California. It is distinguished by dense, sometimes wavy, short hairs covering the leaves and fruit as well as black hairs covering the base of the flowers. It is a rare plant with its distribution ranging from "Nevada to California, along the east-west corridor of the transition desert" (Blomquist et al. 1995). On the NNSS it is known from two locations: Shoshone Mountain in Area 25 and French Peak in Areas 6 and 11. Its habitat is photographed in Figure 5-5.

Two of the French Peak populations on the west side of the peak were visited on May 2, 2019. Healthy plants were found at both known populations as well as a few plants observed westward downslope, which were thought to have been the result of seeds washing down the canyon (Figure 5-6). Many plants were found outside the known distribution for the southern-most west French Peak Population (Figure 5-6). Most plants were past flowering with matured fruits (Figure 5-5), with some plants pre-flowering in the vegetative stage. Although caterpillars were observed on some plants, no herbivory, disease or disturbances were observed as threats to the populations.

Black woollypod grows on "steep hillsides composed of ash-flow volcanic tuff that is typically light gray to reddish-brown" (Blomquist et al. 1995, Hinrichs and McKay 1965). The French Peak populations' habitat is shown in Figure 5-5 with substrate shown in Figure 5-4, and described by MSTS geologist Heather Gang:

"*The habitat is located at the south end of Yucca Flat, on the northern flanks of the Massachusetts Mountains. This part of the Massachusetts Mountains comprises mainly non-welded to welded, Miocene rhyolitic ash flow tuffs of the Topopah Springs and Rainier Mesa Tuffs, with lesser amounts of air-fall tuff (Hinrichs and McKay 1965). These rocks are exposed in places, but are more commonly covered by a thin layer of gravelly colluvium. Lower on the slope within the habitat, thicker alluvium forms the apices of small alluvial fans*."

Figure 5-4. Black woollypod plant past flowering stage with mature fruits.

(Photo by P. Hardesty, May 2, 2019)

Figure 5-5. Black woollypod habitat west of French Peak in Area 6.

(Photo by P. Hardesty, May 2, 2019)

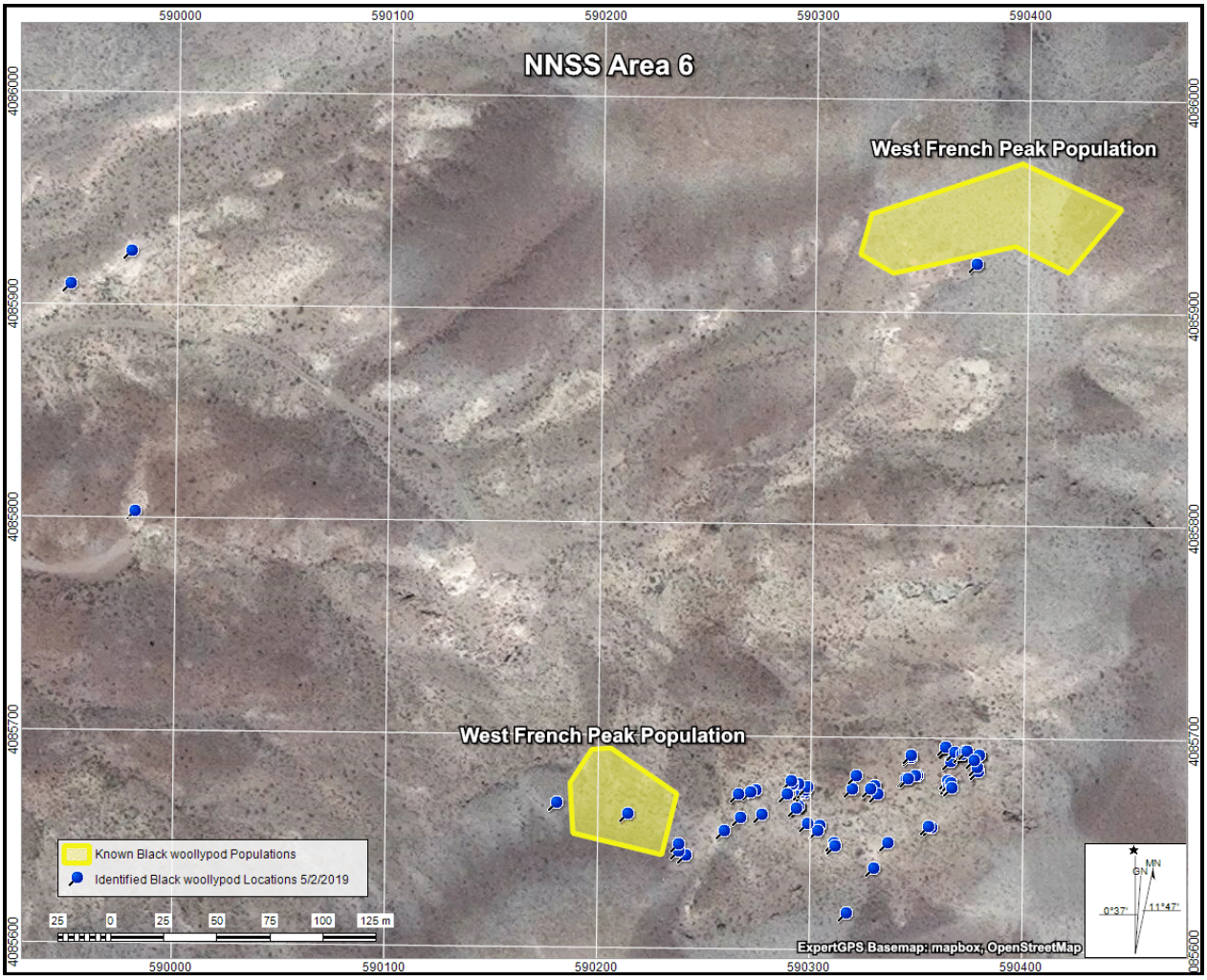

Figure 5-6. Known west French Peak locations of Black woollypod and locations identified during 2019 surveys (UTM [Zone 11, meters], NAD83).

5.2.2 Cane Spring Suncup (*Chylismia megalantha*)

The Cane Spring suncup (*Chylismia megalantha*) is a large annual that blooms in the fall with a showy pink flower and large foliage. The plant grows well on steep slopes and disturbances, including manmade disturbances. It is previously known from five areas on the NNSS and with completion of monitoring surveys in 2019, a sixth location was confirmed: Cane Spring, French Peak, Slanted Butte, Little Skull Mountain, Orange Blossom Road, and new location Area 5 Radioactive Waste Management Complex (RWMC) (Figure 5-7). A similar species, Shockley's evening primrose (*Chylismia heterochroma*), is a smaller version of Cane Spring suncup with differences in the flower at peak maturity. These two species are very similar and overlap in distribution, making the flower at peak maturity essential for positive identification.

Pre-activity surveys at the Orange Blossom Road and French Peak populations were conducted in 2019 in July and August, respectively. Cane Spring suncup is known to grow along Orange Blossom Road in Area 6 (Figure 5-7). The road shoulders were to be bladed to accommodate chip and sealing of the road. No plants were found during this survey nor during the monitoring survey in 2018.

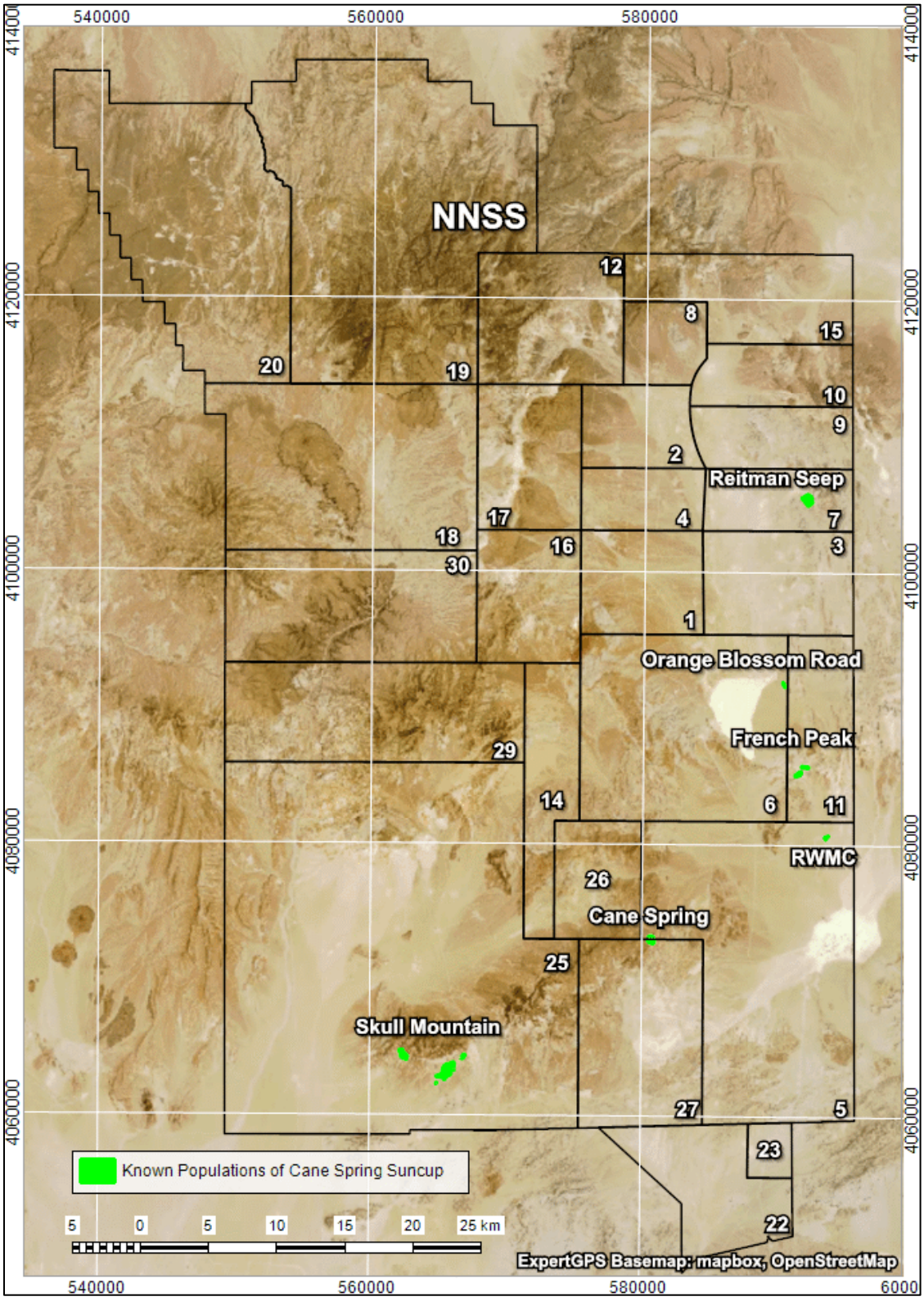

Figure 5-7. Known locations of Cane Spring suncup (UTM [Zone 11, meters], NAD83).

The French Peak population is known to grow along steep slopes just west of French Peak, near an explosives facility. The road and pads for the facility, which are outside the known population, were to be bladed for access in 2019. During the survey, close to 250 plants were observed, some along the road and others just off the road in an area not scheduled for disturbance. The size of the petals and height of the plants resembled Cane Spring suncup but identification could not be confirmed due to the timing of construction occurring prior to peak flower maturity. Upon review of the French Peak population, it is possible this population ranges further than what has been recently mapped. An old population map showed this population to be significantly larger, ranging from the road and pads of the facility, north to the steep slopes west of French Peak and east up to French Peak (Figure 5-8). There have also been several collections outside these mapped areas which have not been confirmed as Cane Spring suncup or Shockley's evening primrose (Figure 5-8).

During a pre-activity survey in 2001, an unidentified *Chylismia* species, which could have been Cane Spring suncup, was found just northeast of the RWMC in Area 5. An opportunistic visit to the area revealed *Chylismia* plants were growing in the summer of 2019. A return visit for a survey in July found approximately 300 Cane Spring suncup plants growing along a manmade berm and a flat disturbed, connected area just north of the berm (Figure 5-7 and 5-8). The plants were identified based on petal size, plant size, and the diagnostic stigma protruding past the anthers at peak maturity (Figure 5-9). The stigma is even with the anthers at peak maturity on Shockley's evening primrose. The area was heavily invaded by invasive species, which did not hinder the growth of Cane Spring suncup (Figure 5-9).

Blomquist et al. (1995) stated "Observations made during surveys on [NNSS] conducted from 1991 to 1994 indicate that there is no clear geographic separation between the two species on [NNSS]". This publication further explains the difficulties of separating these two species as several collections from the NNSS that were previously identified as Cane Spring suncup were annotated in 1994 as Shockley's evening primrose, and vice versa.

5.2.3 Pahute green gentian (*Frasera pahutensis*)

Pahute green gentian has a limited distribution and is endemic to Nye County in Nevada. On the NNSS, Pahute green gentian grows along the southern rim of Pahute Mesa in Area 19 and southwest of Gold Meadows, just north of Rainier Mesa in Area 12. It was first collected at its type locality in 1970 on the NNSS by Janice Beatley, as described by J. L. Reveal (1971), along the southeastern-most edge of Pahute Mesa. This herbaceous perennial can be distinguished within the Gentianaceae family by its white-margined basal leaves and its unique greenish-white to cream or very pale blue, flecked with dark purple flowers (Blomquist et al. 1995, Morefield 1992).

There are seven monitoring locations on the NNSS; six on Pahute Mesa and one near Gold Meadows. The Gold Meadows population in Area 12 was visited on June 4, 2019 (UTM NAD83 568950mE, 4119411mN). This population was last surveyed in 2008. A healthy population of approximately 2,500 plants was observed within the 0.3-ac surveyed plot. A majority of plants (60%) were in flower. No threats to the plants were observed including herbivory, disease or disturbances.

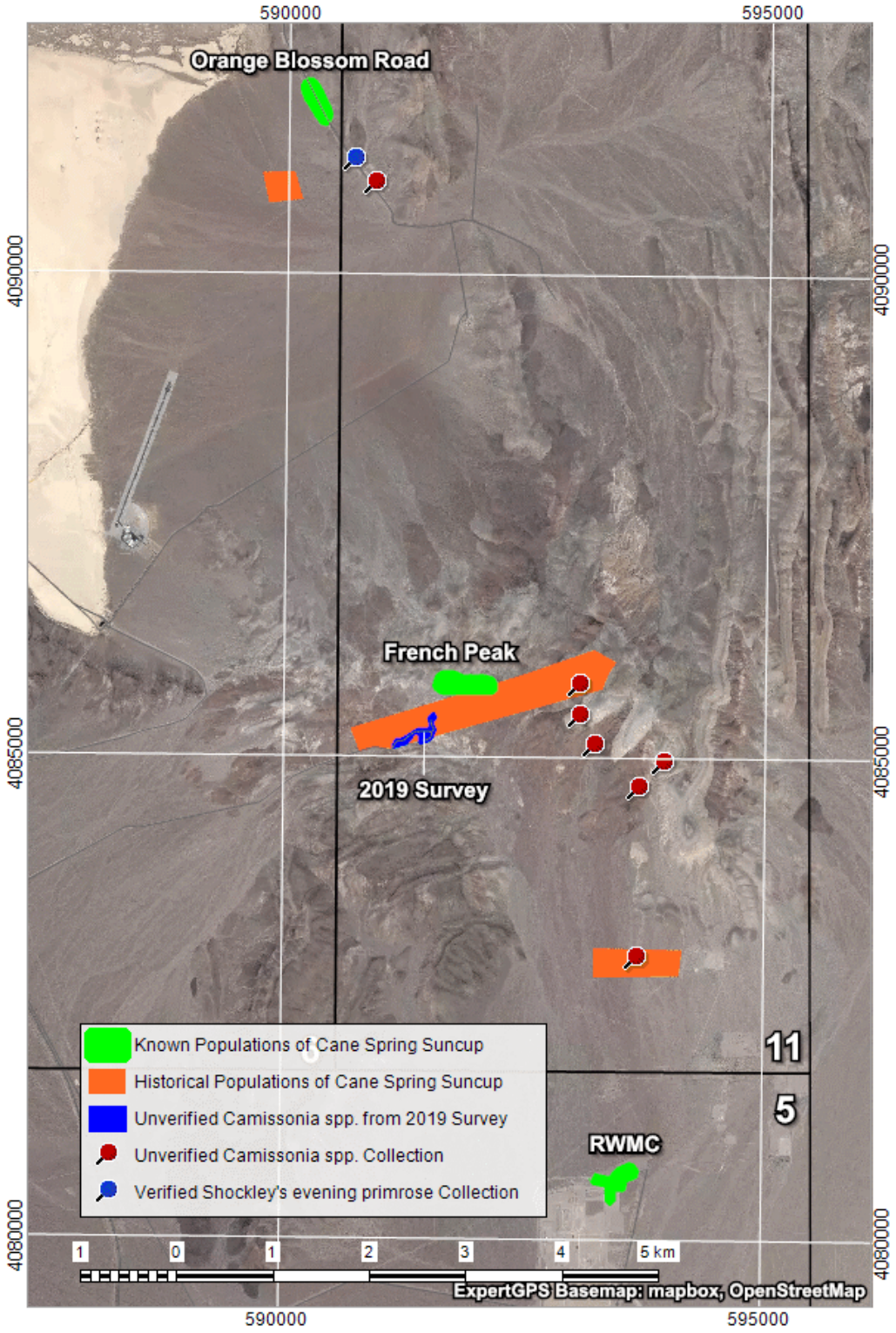

Figure 5-8. Zoomed in map of the Orange Blossom Road, French Peak and RWMC Cane Spring suncup populations. Known populations (green areas), historical populations (orange areas) and locations of collections (red and blue pins) reveal a possible overlap in distribution of Cane Spring suncup and its smaller relative, Shockley's evening primrose (UTM [Zone 11, meters], NAD83).

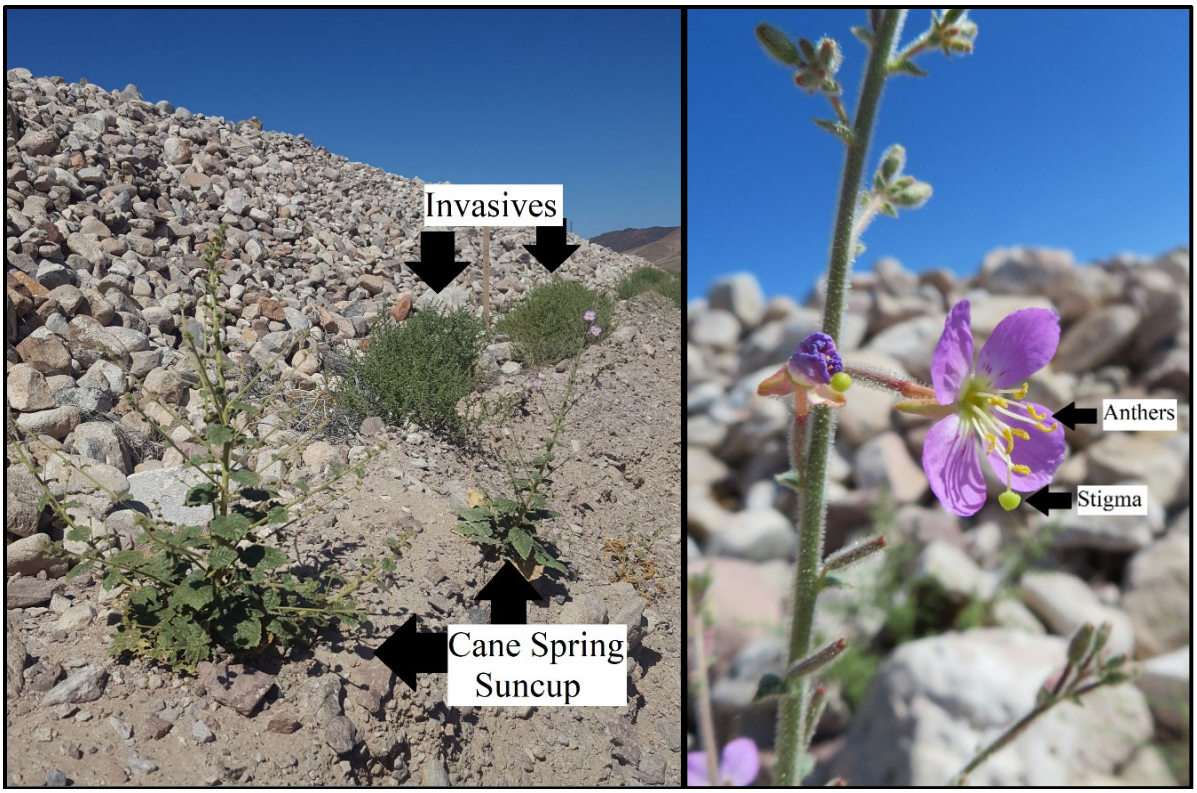

Figure 5-9. Cane Spring suncup growing along manmade berm (left) and flower (right) showing the characteristic stigma (tip of the female part of the flower) extending past the anthers (male part of the flower that holds pollen).

(Photos by J. Perry, July 10, 2019)

5.2.4 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 NNHP List) and *C. ripleyi* var. *ripleyi* (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 (Figure 5-10). *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). The two varieties are not included in *The Jepson Manual: Higher Plants of California* (Baldwin 2012) nor the USDA PLANTS database (USDA, 2020) but are widely accepted by NNHP and NNSS botanists as separate taxa. After a thorough review and surveys of both plants, Hansen et al. (2010) stated that, "Based on the lack of evidence that both varieties of *C. ripleyi* are occurring at the same location and the unique habitat preference for both varieties, *C. ripleyi* var. *saniculoides* will continue to be considered a valid taxon and will be monitored along with other sensitive plants known to occur on the [NNSS]."

With above average winter precipitation and an extended bloom into summer months, it was a good year for Sanicle biscuitroot in 2019. Monitoring surveys were completed at the Slanted Butte and Yucca Flat populations as well as several opportunistic observations in Rock Valley in Areas 22 and 27.

The Yucca Flat population located near the intersection of Mercury Highway and Pahute Mesa Road in Areas 1 and 3 (UTM NAD83 584337mE, 4099902mN) was visited in March. Eleven immature plants (in the beginning vegetative state and not flowering) were observed. Evidence of herbivory was observed on

other plants in the area, but not Sanicle biscuitroot The Slanted Butte population located along Papoose Road in Area 9 (UTM NAD83 591817mE, 4108756mN) was visited in March. Six immature plants were observed. There were many annuals growing in the area as well as a few Joshua trees in bloom. Had this site been visited later in the spring, more plants may have been observed. Both the Yucca Flat and Slanted Butte populations that were surveyed were not in bloom, therefore the flower color could not be recorded.

Opportunistic sightings in 2019 of *C. ripleyi* var. *saniculoides* in Rock Valley in Areas 22 and 27 led to additional surveys in the area, which resulted in the discovery of two new populations and the expansion of three known populations (Figure 5-11). It is possible all sandy washes in this area are potential *C. ripleyi* var. *saniculoides* habitat. The two new population locations were confirmed as *C. ripleyi* var. *saniculoides* by observing the plant's purple flowers that bloomed in April.

During annual wildland fire fuel surveys, *C. ripleyi* var. *saniculoides* was found at survey point 127 in Area 2 (UTM NAD83 582752mE, 4111804mN). This is a known location for this plant in northern Yucca Flat. The number of plants observed was not recorded.

Figure 5-10. *C. ripleyi* var. *saniculoides* growing in a wash along a power line road in Area 22.

(Photo by J. Perry, April 18, 2019)

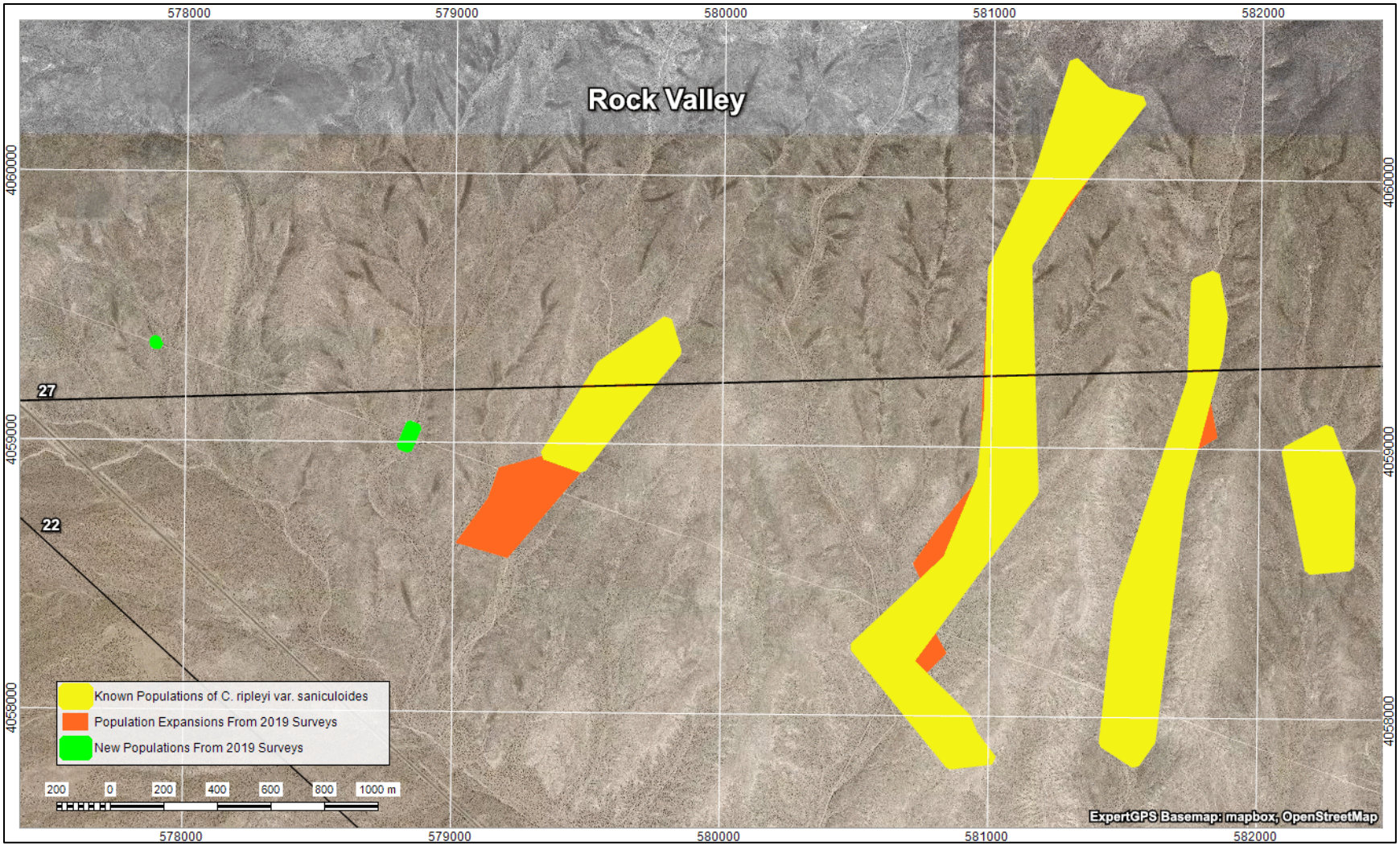

Figure 5-11. Rock Valley (Areas 22 and 27) populations of *C. ripleyi* var. *saniculoides* updated from 2019 surveys (UTM [Zone 11, meters], NAD83).

5.2.5 Weasel phacelia (*Phacelia mustelina*)

Weasel phacelia (*Phacelia* mustelina) is a widely distributed, small annual plant with a violet flower and a strong, disagreeable odor. The plant was given the ranking of "marginal" in the 2012 EMAC report as "It does not occur in large numbers but does occur over most of the NNSS as well as at many locations off the NNSS" (Hall et al. 2013). The plant is listed on the NNHP List and the NNSS sensitive plant monitoring list but has few threats on the NNSS.

One location that Weasel phacelia grows is on the steep southwest slopes of Skull Mountain in Area 25. This population overlaps with another sensitive plant species, Beatley scorpionflower (*Phacelia beatleyae*) (Figure 5-12, UTM NAD83 569324mE, 4065770mN). This location was visited in April 2019 with the intent to document Beatley scorpionflower which was not found, but at least 200 Weasel phacelia plants were found. The plants were not in bloom, but displayed the plant's characteristically irregularly toothed, hairy leaves (Figure 5-12). As only a small area was surveyed, it is assumed many more plants would have been observed at a later visit.

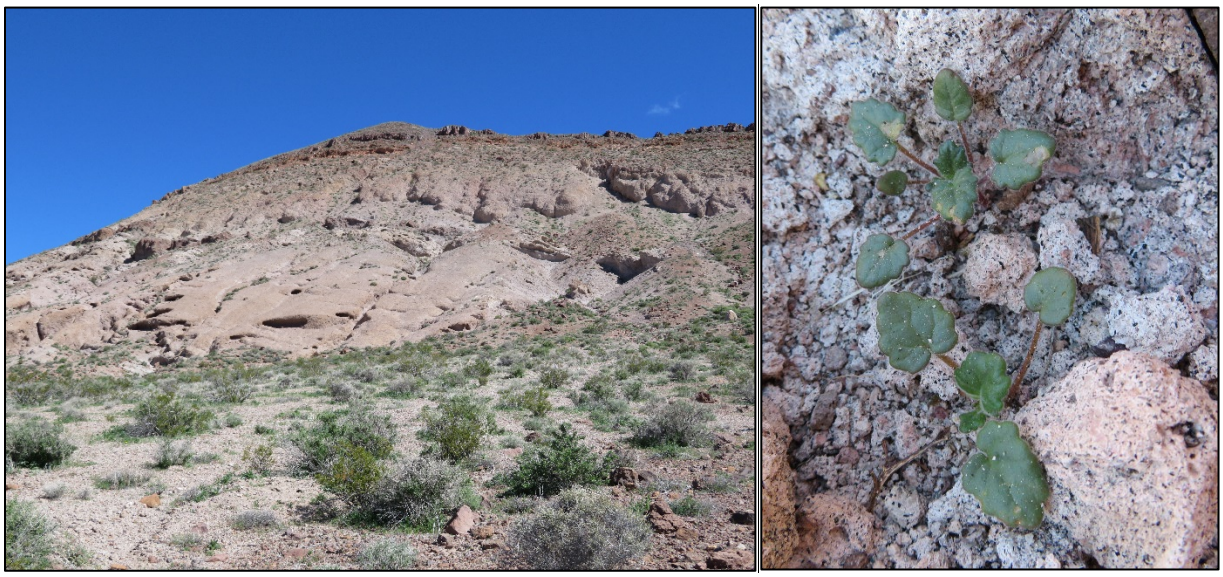

Figure 5-12. Weasel phacelia habitat on the steep slopes of Skull Mountain in Area 25 (left) and immature plants (right).

(Photos by J. Perry, April 3, 2019)

5.2.6 Rock purpusia (*Ivesia arizonica* var. saxosa)

In 2018, MSTS biologists collected leaf and seed samples of Rock purpusia (*Ivesia arizonica* var. *saxosa*) to contribute to genetic research on Rock purpusia varieties. This variety is identified by its five separate white petals. In 2019, a Silent Canyon population on Rainier Mesa in Area 19 was visited in August to collect a pressed specimen of the plant for the same study (UTM NAD83 554253mE, 4123453mN). The plant was found locally abundant throughout rock crevices along a power line road. It was a healthy population with no apparent threats. Two plants were collected, pressed, and sent to the Department of Biology, University of Nevada in Reno.

5.3 COORDINATION WITH OTHER SCIENTISTS

- MSTS biologists continue to attend the Nevada Native Plant Society Southern Chapter monthly meetings, when available. The meetings host a network of botanists familiar with Nevada native plants. The meetings focus on current information and updates in southern Nevada related to the status of important plant species, botany networking events and the need for collaboration between government agencies on plant research. An MSTS biologist presented at the February 2019 meeting on the *Status of Sensitive Plant Species on the NNSS* in Las Vegas, Nevada. This same presentation was presented at the April 2019 Northern Chapter meeting in Reno, Nevada.

- An MSTS biologist attended a workshop on plant identification hosted by the Friends of the Jepson Herbarium in U.C. Berkeley, California in May 2019. The workshop provided hands-on experience with keying out plants using the newest edition of *The Jepson Manual: Higher Plants of California* (Baldwin 2012).

- MSTS biologists attended the Nevada Rare Plant Workshop in October 2019 hosted by the Nevada Native Plant Society and the Nevada Natural Heritage Program in Las Vegas, Nevada. The workshop allows botanist, government agencies and other interested parties to discuss conservation priority of rare Nevada native plants. Two sensitive plant ranking lists were discussed during the workshop: the NNHP List and the Nevada Native Plant Society List.

6.0 SENSITIVE AND PROTECTED/REGULATED ANIMAL MONITORING

The NNHP Animal and Plant At-Risk Tracking List (NNHP 2020); NAC 503, "Hunting, Fishing and Trapping; Miscellaneous Protective Measures" (NAC 2020); FWS Endangered Species home page (FWS 2020); 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 pinyon jay (*Gymnorhinus cyanocephalus*) was added as a sensitive species. 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 2019 focused on (a) birds, (b) bats (c) feral horses, (d) mule deer, (e) pronghorn antelope, (f) desert bighorn sheep, and (g) mountain lions. Information about other noteworthy wildlife observations, the southeast Nevada pyrg (*Pyrgulopsis turbatrix*) conservation strategy, bird mortalities, and a summary of nuisance animals and their control on the NNSS is also presented.

6.1 BIRDS

Bird monitoring on the NNSS during 2019 focused on Migratory Bird Treaty Act (MBTA) Compliance, documenting bird mortalities, implementing the NNSS Avian Protection Plan, conducting winter raptor surveys, and a western burrowing owl radio-tracking study.

6.1.1 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 (*Sturnus vulgaris*), English house sparrow (*Passer domesticus*), rock dove or pigeon (*Columba livia*), and the Eurasian collared dove (Federal Register, Volume 70, Number 49, March 15, 2005). The chukar and Gambel's quail (*Callipepla gambelii*) are also not protected under the MBTA but are regulated by Nevada state law as gamebirds. A change in the way the MBTA has been interpreted was written in a FWS Memorandum M-37050 on December 22, 2017. Up until now the MBTA has prohibited the intentional and incidental take of migratory birds. M-37050 changes that interpretation to state, "the Migratory Bird Treaty Act does not prohibit incidental take." The impacts of this change are not known at this time but will be addressed as more information becomes available.

Executive Order (EO) 13186 *Responsibilities of Federal Agencies to Protect Migratory Birds* 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 EO 13186. This MOU is currently being updated.

Actions taken to comply with the MBTA and MOU during 2019 included the following: 1) conducted preactivity surveys for proposed projects before surface-disturbing work to avoid harming birds or their nests, 2) treated injured Say's phoebe and released it and removed a common raven from an underground facility and released it, 3) installed bird guard, protective covers and other retrofits on power lines to reduce avian mortality, and 4) reported dead/injured birds to FWS.

6.1.2 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

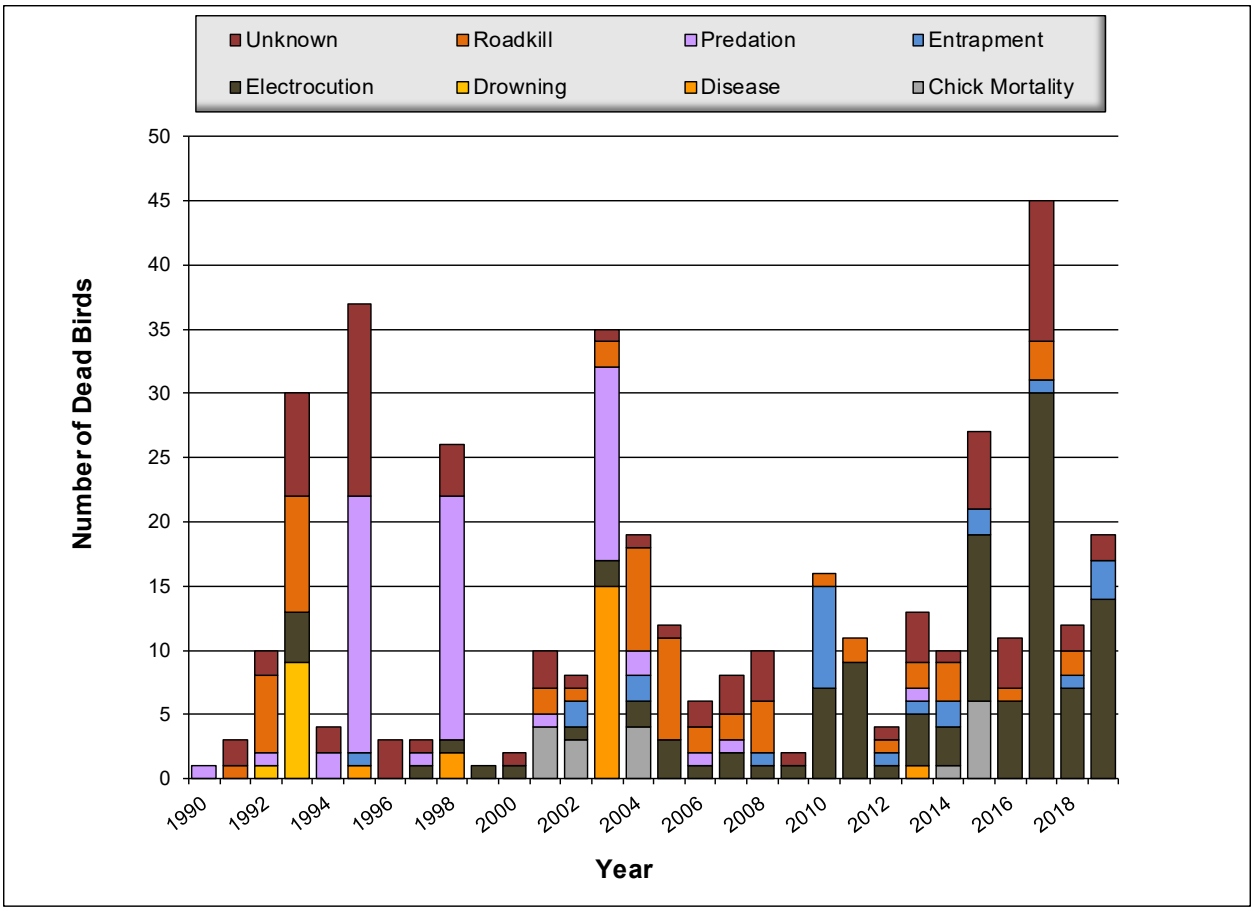

Figure 6-1. Records of reported bird deaths on the NNSS, 1990–2019.

mortalities. Other causes of death include predation and disease and in many instances the cause of death is unknown. Workers and biologists work together to observe and report mortalities. A total of 19 dead birds were documented on the NNSS in 2019 (Figure 6-1). Fourteen (4 red-tailed hawks [*Buteo jamaicensis*] and 10 common ravens) were electrocuted, one red-tailed hawk was found severely injured due to unknown causes and was euthanized, one northern harrier (*Circus cyaneus*) was injured due to unknown causes and died the next day, and three European starlings (*Sturnus vulgaris*) were found dead due to entrapment. No golden eagle deaths were documented.

Numerous poles were identified by MSTS biologists and the power group to install retrofits or reconfigure to make them avian friendly (Figure 6-2). A total of 157 poles were retrofitted or reconfigured during 2019. A variety of retrofits were made including installing insulator covers and extenders, perch deterrents, conductor wire covers, and fuse covers. MSTS biologists also conducted surveys at 57 pole sets to assess if they were avian-friendly and to look for bird carcasses. No dead birds were found and 10 (18%) were identified as not avian-friendly. These have been added to a list for future retrofit consideration.

Figure 6-2. Retrofitted pole with conductor wire covers, insulator covers, and extenders.

(Photo by D.B. Hall, April 5, 2017)

6.1.3 Implementing the NNSS Avian Protection Plan

The NNSS Avian Protection Plan (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 2019 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.

- 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 Endangered Species Act). All permit conditions were met and an annual report summarizing 2019 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 MSTS biologists to remove active nests at project sites in emergency situations and possess and transport carcasses of golden eagles and other bird species. All permit conditions were met and an annual report summarizing 2019 activities was submitted to FWS. This included entering all bird mortality injuries and mortalities into the Injury and Mortality Reporting system, a FWS electronic database. Nevada Department of Wildlife (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 2019 activities was submitted to NDOW.

- Several mortality reduction measures were taken. These include the aforementioned retrofits on 157 power poles, identifying several poles for future retrofits, removing two inactive nests, surveying 141 ha at 33 project sites for active bird nests, and removing several dead rabbits and snakes from roads to reduce the potential for vehicle mortalities. These measures were effective at reducing avian mortalities.

6.1.4 Winter Raptor Surveys

Winter raptor surveys were initiated during 2014, in an effort to better understand wintering raptors on the NNSS and as a collaborative effort to provide data to the U.S. Army Corps of Engineers' (USACE) nationwide mid-winter bald eagle (*Haliaeetus leucocephalus*) survey and NDOW's statewide monitoring effort. Surveys continued in 2019, and were conducted by driving a standard route to identify all raptors observed (i.e., eagles, hawks, owls, and vultures). Two official routes were established on the NNSS: Southern NNSS, Route #60 (83 kilometers [km]), and Yucca Flat, Route #61 (75 km) (Figure 6-3). Data including common name, UTM coordinates (NAD 83), 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 were conducted January 8 (Southern NNSS) and January 9 (Yucca Flat) to coincide with the national bald and golden eagle (*Aquila chrysaetos*) survey and on February 18 (Southern NNSS) and February 12 (Yucca Flat).

The intent is for these surveys to be conducted each year for numerous years 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 were also recorded because ravens are known desert tortoise predators, and the loggerhead shrike is a sensitive species. The southern route is located primarily in the Mojave Desert portion of the NNSS while the Yucca Flat route 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).

Results are found in Table 6-1. Only three golden eagle sightings were documented during the surveys; one each on the Yucca Flat route during the January and February surveys and one on the southern NNSS route during the January survey. This is quite a few less than last year's total of 11 golden eagle sightings across all surveys. The red-tailed hawk was the most common species detected on both routes, comprising nearly two-thirds of all raptor sightings (Table 6-1). Common ravens were more prevalent on the southern route this year than in Yucca Flat with most of them observed near the Mercury Sewage Lagoons. Data

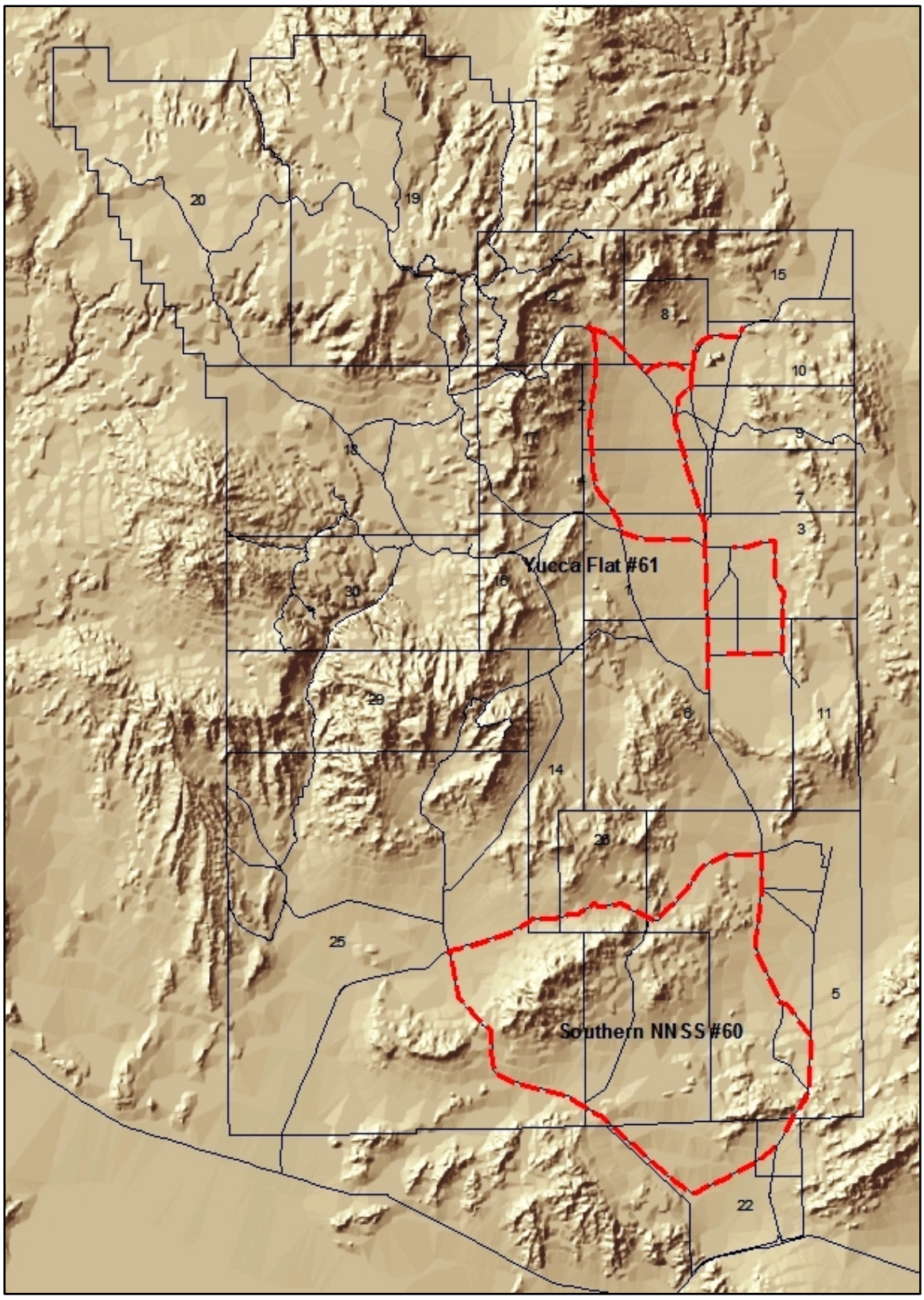

Figure 6-3. Winter raptor survey routes (red lines) on the NNSS.

Table 6-1. Results of winter 2019 raptor surveys on the NNSS.

Species	Southern NNSS (1/8/19)	Southern NNSS (2/18/19)	Yucca Flat (1/9/19)	Yucca Flat (2/12/19)
Golden Eagle (*Aquila chrysaetos*)	1	0	1	1
Red-tailed Hawk (*Buteo jamaicensis*)	0	2	5	5
Praire Falcon (*Falco mexicanus*)	0	0	0	0
American Kestrel (*Falco sparverius*)	0	0	1	2
Northern Harrier (*Circus cyaneus*)	0	0	0	1
Total Raptors	**1**	**2**	**7**	**9**
Common Raven (*Corvus corax*)	10	4	0	3
Loggerhead Shrike (*Lanius ludovicianus*	0	0	0	0

were entered into the Ecological Geographic Information System (EGIS) faunal database, and given to NDOW and the USACE for inclusion in their analyses.

6.1.5 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 wintering range.

New technology has recently become available to use satellites and Global Positioning Systems (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, PTT transmitters (Microwave Telemetry, Incorporated) are light enough to attach to western burrowing owls and not exceed the general rule of adding no more than 5% of an animal's body weight when attaching transmitters or other devices.

In June, a collaborative study between MSTS, Dr. Courtney Conway (USGS, University of Idaho), and Carl Lundblad resulted in the capture of seven western burrowing owls. PTT transmitters were attached to each owl (Figure 6-4) as well as a FWS-approved leg band. Other data including age, sex, reproductive status, wing length, tail length and tarsus length were taken (Table 6-2). Owl locations were monitored periodically through December 31. In mid-October owls started migrating south. By mid-December one female (180445) was presumed to be near its capture location at the Big Explosives Experimental Facility in Yucca Flat, and its male (180443) mate was near the Salton Sea in southern California. Male (180446) and its female mate (180442) were on the west coast of Baja California, Mexico about 200 km apart. Female (180447) was last detected in Sheephole Valley, California in mid-October and appeared to still be moving and its male mate (174480) was just outside of Joshua Tree, California. Both are presumed dead or have shed their transmitters. Female (180444) was on the east side of Baja California, about 45 km north of the Baja California Sur border (Figure 6-5). These results reveal wintering locations of NNSS owls for the first time with three migrating to Baja California and three to southern California. Coarse migration routes are shown by scattered dots (Figure 6-5). Figure 6-6 shows the capture locations (pink

bird icons) and the distribution of the seven marked owls on and near the NNSS from capture until they migrated. All but one owl (Female 180445) remained on or near the NNSS through mid-October.

One (174480) transmitter had not moved for a while and it was assumed the owl was dead or the transmitter had become detached. On December 21, a MSTS biologist searched for the transmitter near Joshua Tree National Park but was unsuccessful in locating it. Mike Valmstad, a biologist from Joshua Tree National Park went out an additional four times searching for the transmitter with no success. No sign of the owl or the transmitter were found so it is unknown if the owl died or if the transmitter fell off. Owls will continue to be monitored as long as the transmitters are working to learn more about their migratory patterns, and additional owls may be captured and tracked in the future.

Figure 6-4. Western burrowing owl with PTT transmitter attached.

(Photo by D.B. Hall, June 17, 2019)

Table 6-2. Results of western burrowing owl captures and wintering locations for seven owls.

Date	USFWS Band#	PTT#	Capture Location	Age	Sex	Brood Patch	Wing	Tail	Tarsus	Winter Location
6/17/2019	934-48849	180445	BEEF, Yucca Flat	AHY	Female	Wrinkly	171	78	66.5	BEEF, Yucca Flat
6/17/2019	934-48850	180443	BEEF, Yucca Flat	AHY	Male	None	170	80	68	Salton Sea, California
6/17/2019	934-48851	180444	8DPad, Yucca Flat	AHY	Female	Vascularized	168	74	66.3	Baja California east side
6/17/2019	934-48852	180442	Buckboard Mesa Road #1	AHY	Female	Wrinkly	172	76	66.2	Baja California west side
6/17/2019	934-48853	180446	Buckboard Mesa Road #1	AHY	Male	None	181	80	68.1	Baja California west side
6/17/2019	934-48854	180447	Buckboard Mesa Road #2	AHY	Female	Wrinkly	170	74	68	East of 29 Palms, Sheephole Valley
6/18/2019	934-48855	174480	Buckboard Mesa Road #2	AHY	Male	None	169	76	70.9	Twentynine Palms

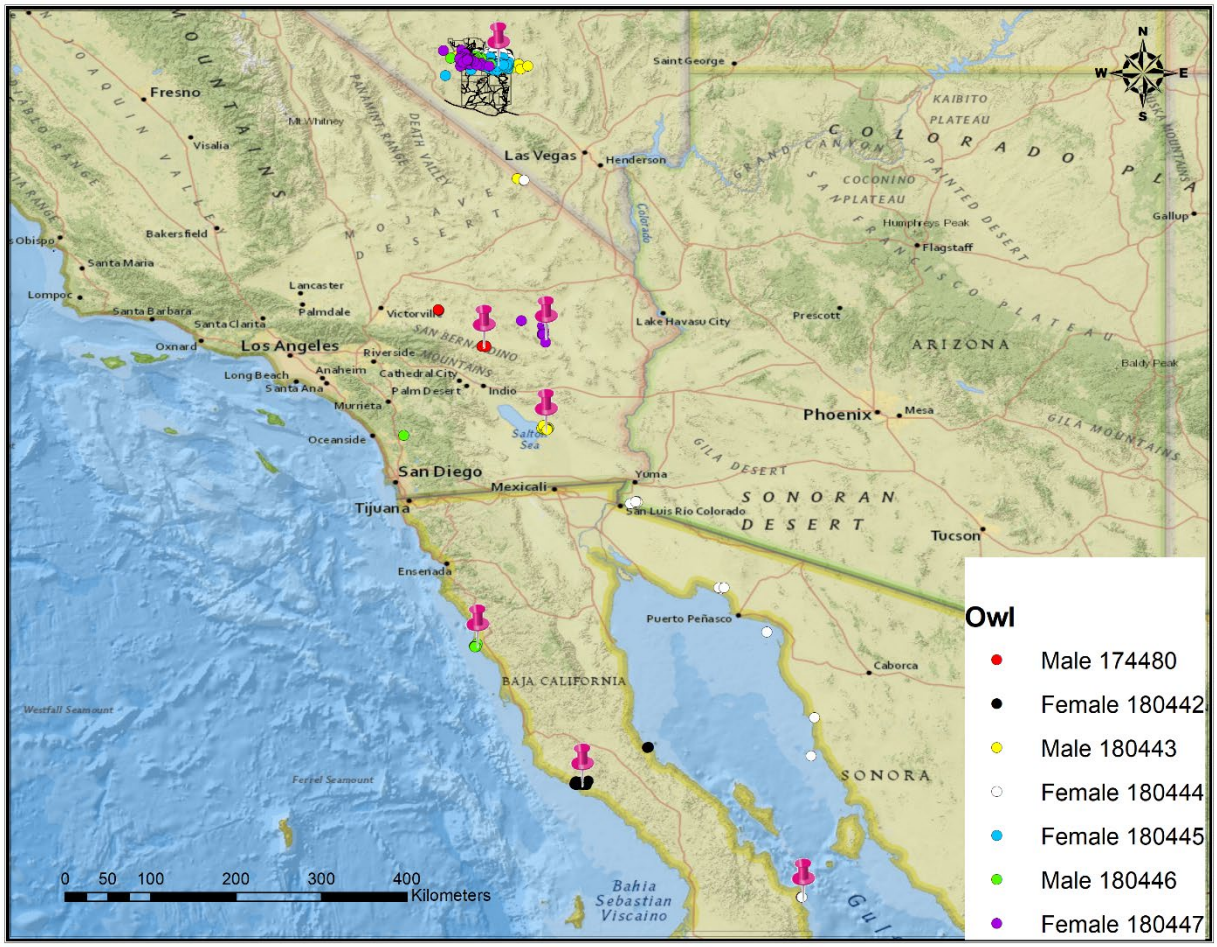

Figure 6-5. Map of wintering sites (pink pins) and coarse migration routes (various colored dots) for seven western burrowing owls captured on the NNSS.

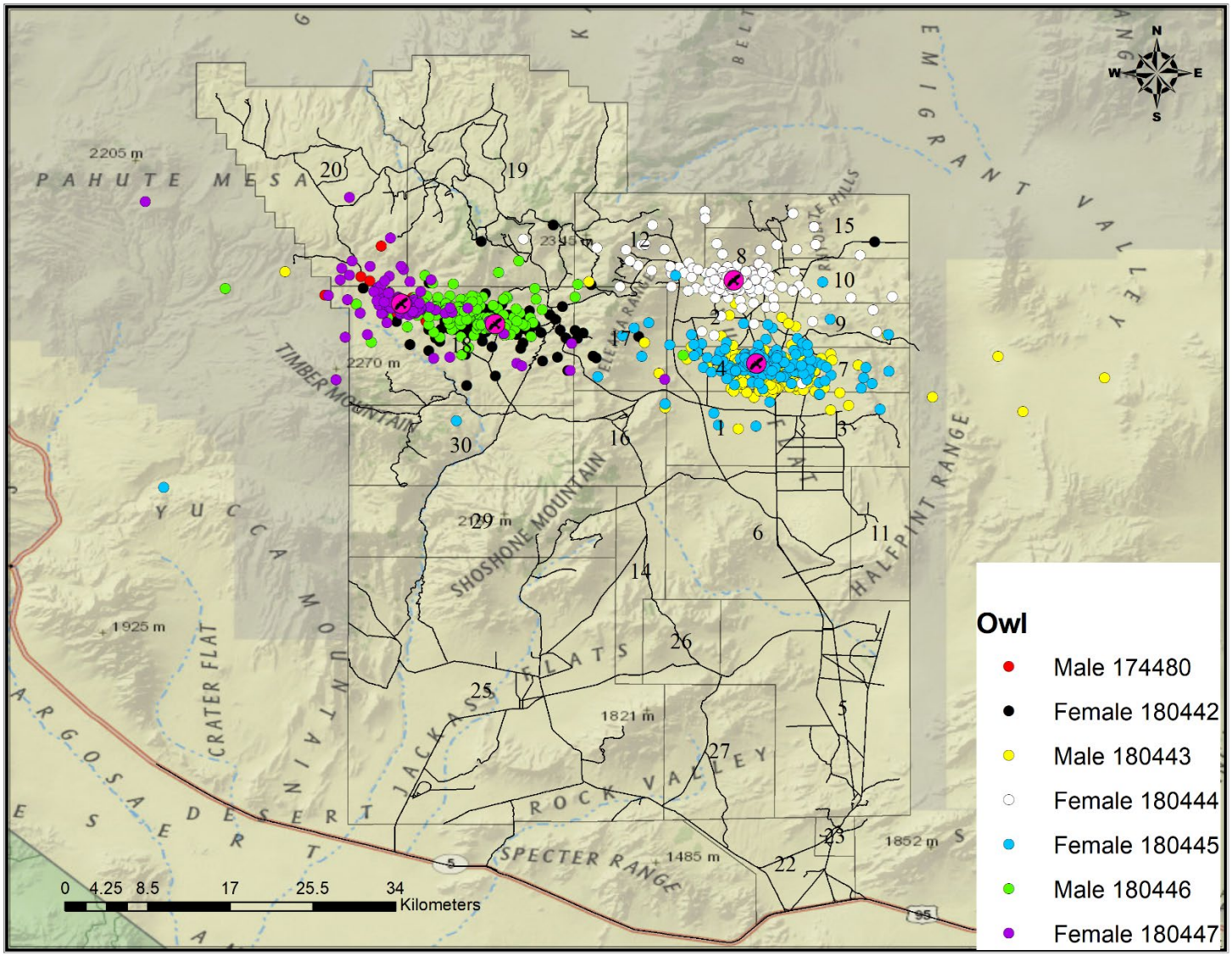

Figure 6-6. Map of locations of seven marked western burrowing owls on and near the NNSS from capture (pink bird icons) (mid-June) to time of migration away from NNSS (mid-October to December 2019).

6.2 BAT SURVEYS

Bat monitoring in 2019 consisted of removing bats from buildings and documenting the roost sites. Four California myotis (*Myotis californicus*) were found under the roof of Building 23-160 during roof repairs in early January. Two adult females were injured and had to be euthanized and two of unknown sex flew away. One myotis species was found inside the new building in Mercury (23-460) and was released west of Mercury. One myotis species was found dead in a box car behind Building 23-651 and the carcass was properly disposed of. Roost site locations at these buildings were entered in the EGIS faunal database.

6.3 FERAL HORSE SURVEYS

Monitoring was conducted in 2019 to determine the abundance and distribution of feral horses on the NNSS with survey routes, opportunistic sightings and camera traps (see Table 6-5 in Section 6.7.1 Motion-Activated Cameras). A previously-used, standard rubric for horse color, body features, body markings, facial marking and leg markings was used to identify and count individual horses. Surveys were conducted during the spring and summer at several locations including Camp 17 Pond (Figure 6-7), Airport Road, Pahute Mesa Road, and Gold Meadows. Biologists identified 57 individuals in at least seven different bands; 17 females, 21 males, and 19 of unknown sex (Patty Hardesty, MSTS, personal communication, June 8, 2020). The total includes 9 juveniles and 6 foals. This is a substantial increase from 40 individuals in 2018 with 6 new males and 10 new horses of unknown sex. Monitoring will continue to determine if this upward trend continues.

Based on opportunistic sightings and camera results, horses were observed in the same areas as previous years. No horses were documented using Captain Jack Spring for the sixth consecutive year. Numerous horse photos were taken at Camp 17 Pond (338 images) and Gold Meadows Spring (75 images) (Table 6-5). These water sources are the core areas used by horses, especially during the hot, dry summer months.

Figure 6-7. Group of bachelors headed to water at Camp 17 Pond.

(Photo by P. Hardesty, June 20, 2019)

6.4 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 2006-2019. In past years, the monitoring effort has emphasized estimating relative abundance and density but since 2016 survey efforts have focused solely on relative abundance.

6.4.1 Trends in Mule Deer Abundance

Mule deer abundance on the NNSS was measured by driving two standardized (59 km total length) road courses (Figure 6-8) to count and identify mule deer. One route (29 km) was centered around Rainier Mesa, and the second (30 km) was centered around the eastern portion of Pahute Mesa. 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, 2019, a total of 119 deer were observed on both routes combined, which equates to an average of 19.8 deer per night. This is slightly higher than 2018 results with 115 deer observed and an average of 19.0 deer per night. On average, this is about 10 deer per night lower than the long-term average since 1989. There has been a decreasing trend ($y = -2.2416x + 48.096$, $r^2 = 0.56$) the last 14 years with counts fluctuating widely (Figure 6-9). The trend for the entire study period (1989-2018, excluding 1995-1998 and 2001-2005) is nearly flat ($y = -0.1117x + 31.364$, $r^2 = 0.0082$). The standard deviation in 2019 for nightly counts was one of the lowest recorded since 2006 (Figure 6-9), and deer counts ranged from 12 to 30 deer per night. Specific causes for the fluctuation in deer numbers is unknown and requires further investigation.

Unlike the last two years, the number of deer per 10 km was higher on Pahute Mesa than Rainier Mesa in 2019 (Figure 6-9). A total of 63 deer groups were detected. Group size varied from 1 to 7 animals. Average group size was nearly equal between the Pahute Mesa and Rainier Mesa routes (1.8 and 2.1, respectively).

6.4.2 Sex and Fawn/Doe Ratios

The deer sex ratio (number of bucks per 100 does) decreased from 105 in 2018 to 87 in 2019, which is substantially lower than the average of 107 (2006-2019) (Table 6-3). These sex ratios have varied greatly on the NNSS since 2006. 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) in 2019 was 21 in 2019 which is a little lower than the last two years (26) (Table 6-3) and the average of 25 for the period 2006-2019. The percentage of individuals unclassified to sex in 2019 was 17.6% which is about the same as the average percentage of unclassified sex since 2006 (17.9%). 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.

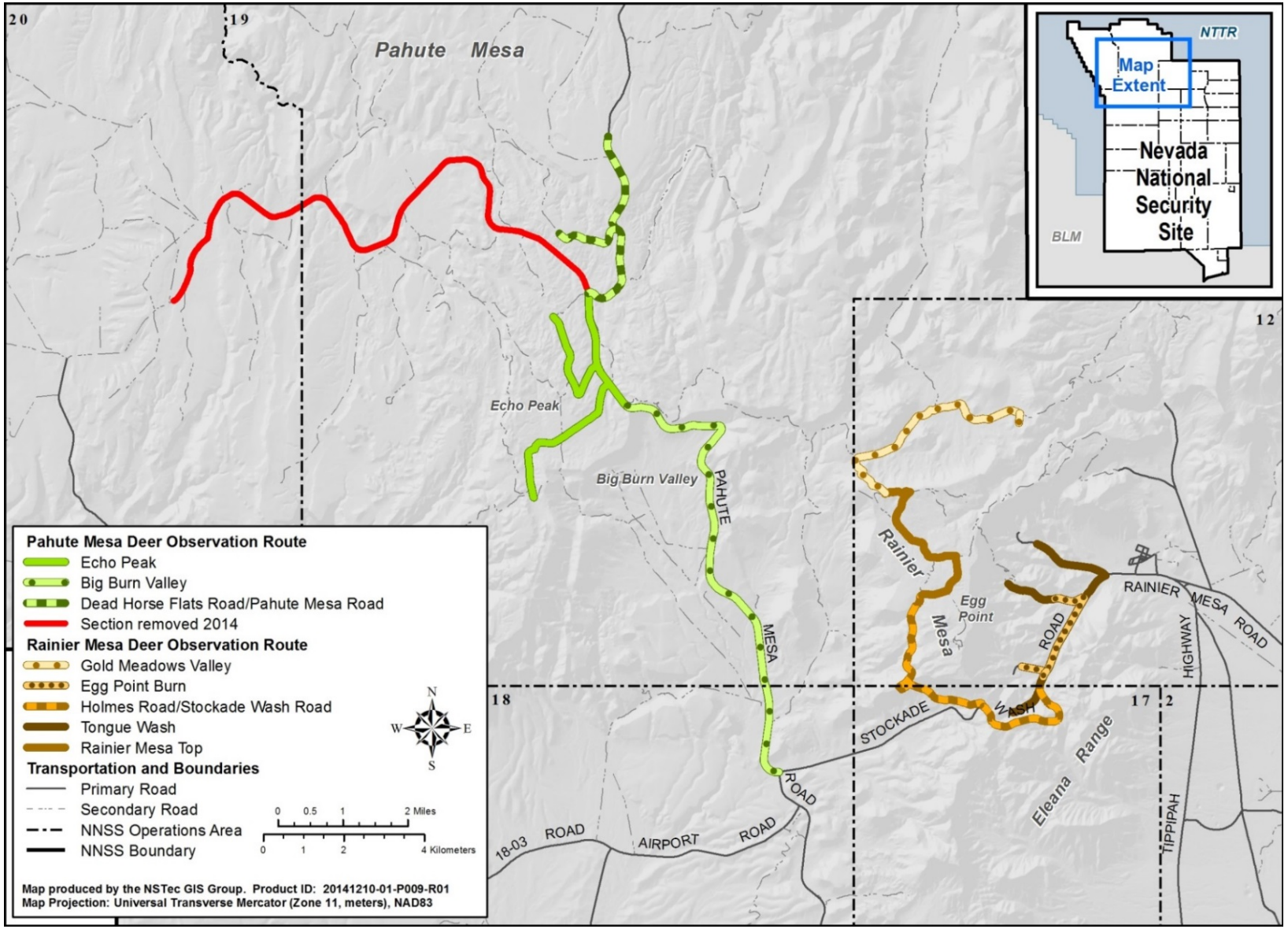

Figure 6-8. Road routes and sub-routes of two NNSS regions driven in 2019 to count deer and section removed due to road closure.

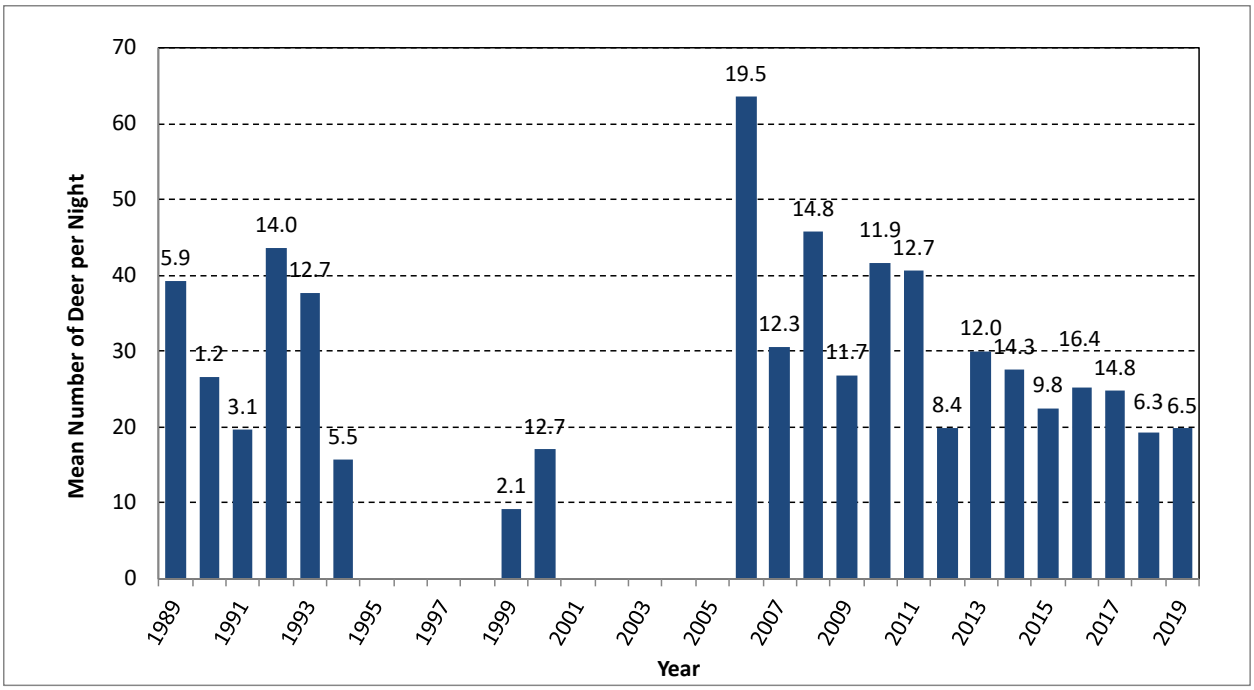

Figure 6-9. Trends in total deer count per night from 1989 to 2019 on the NNSS (surveys were not conducted during 1995–1998 or 2001–2005). Standard deviation values above bars.

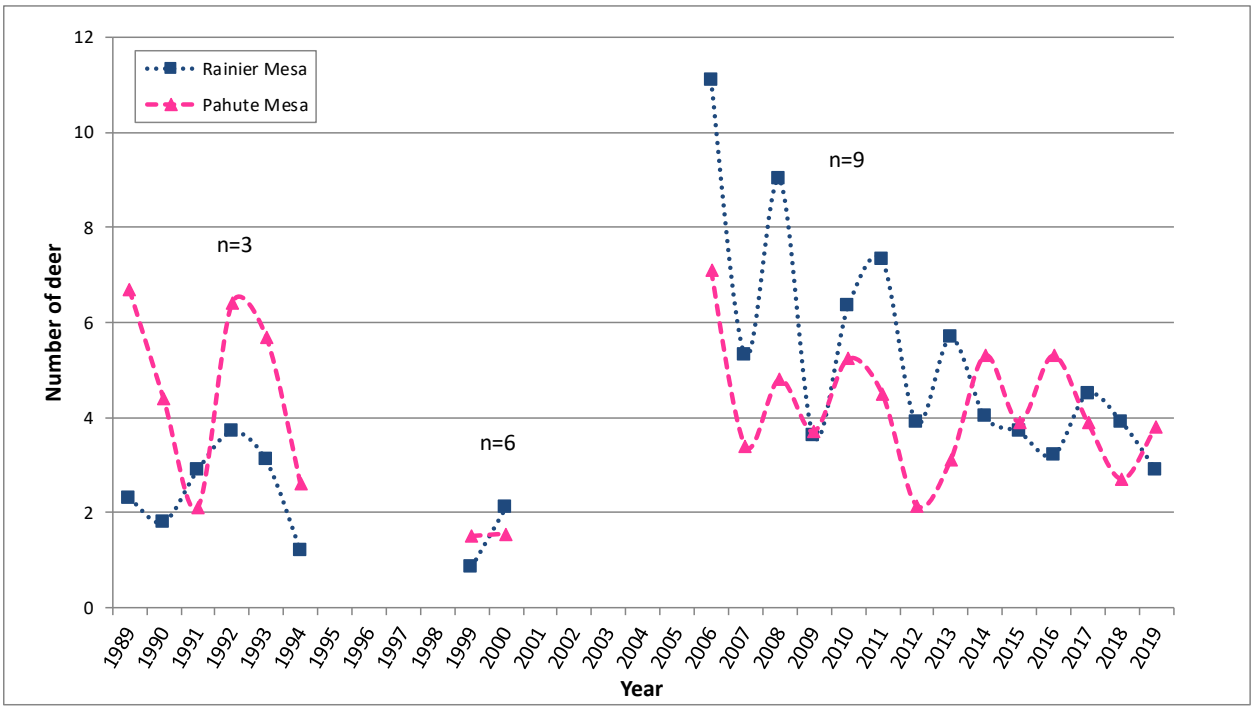

Figure 6-10. Mean number of mule deer per 10 km per night, counted on two routes (n = number of survey nights; exceptions n = 12 for 2012, n = 8 for 2013, n = 6 for 2015–2019).

Table 6-3. Mule deer classified by sex and age, with sex ratios, and fawn to doe ratios from 2006 to 2019 on the NNSS (12 survey nights for 2012, 8 for 2013, 6 for 2015–2019, 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

6.4.3 Fall Distribution Surveys

A research study involving the capture and radio-collaring of mule deer on the NNSS to better understand their habitat use and movements was initiated in November 2019 (See 6.5 Mule Deer and Pronghorn Antelope Distribution Study). In order to locate mule deer and facilitate captures, spotlight surveys were conducted on November 13 on both the Pahute Mesa and Rainier Mesa routes. A total of 7 deer were observed (3 bucks, 2 does, and 2 unknown) on the Pahute Mesa route. Most of these were found near the Echo Peak area. Thirteen deer (3 bucks, 7 does, 1 fawn and 2 unknown) were observed on the Rainer Mesa route, all of which were on the eastern slope of Rainier Mesa at lower elevations.

6.5 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 typically 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 an 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 initiated in November 2019 to better understand the potential radiological dose to the off-site public via the hunter pathway. This was a true collaborative effort involving 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 MSTS biologists. Native Range Capture Services (David Rivers, pilot and his crew) was contracted to capture the animals using net guns from a helicopter. NNSA/NFO and DOE Environmental Management Nevada Program 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 the vegetation, and 8) assess the overall health, disease status, and genetics of NNSS mule deer and pronghorn.

On November 15-17, the aforementioned collaborators along with several volunteers assembled to capture the mule deer and pronghorn. Six staging areas (Figure 6-11) were used to capture animals from a variety of locations focusing on sites close to contaminated areas such as Yucca Flat, Frenchman Flat and E Tunnel Ponds. The intent was to bring as many animals as possible, especially pronghorn which are more susceptible to capture-related injuries, to the staging area for physiological monitoring and health assessments before they were released (Figure 6-12). In addition, radiological burden measurements using a direct count method were taken on several animals at the staging areas. A total of 23 mule deer (16 does, 7 bucks) and 20 pronghorn (14 does, 6 bucks) were captured (Table 6-4). All 23 mule deer were radio-collared and ear-tagged. Ten of the animals were brought to a staging area (6 Area 19 Echo Peak, 4 Area 12 E Tunnel Road) for processing and 13 were processed in the field at the capture location. Thermoluminescent dosimeters (TLD's) were attached to 12 mule deer doe radio-collars to estimate external radiological dose. Eighteen pronghorn (12 does, 6 bucks) were radio-collared and ear-tagged, and TLD's were attached to the collars of 8 does and 4 bucks to estimate external radiological dose. Of the 20 pronghorn 17 were processed at a staging area (6 Area 5 Frenchman Flat, 11 Area 7 Yucca Flat) and 3 were processed in the field. One yearling female died at the staging area and was neither radio-collared nor ear-tagged, and one female was ear-tagged but not radio-collared due to abrasions on the neck area. One pronghorn doe (705944) was mistakenly captured twice, once on November 15 when it was ear-tagged but not radio-collared and again on November 17 when it was radio-collared.

After capture, a radio-collar was carefully affixed around the neck, a unique combination of ear tags was attached (Figure 6-13) and the animal's age, sex, and rectal body temperature were recorded (Table 6-4). Blood was also collected for disease, genetic, and radiological analyses (see Section 6.8 Radiological Sampling). Animals processed at the staging area had additional data taken including body weight, body condition score, and neck circumference (Table 6-4). Heart rate, respiration rate and eye, ear, and leg checks were also conducted to ensure the health of the animal before release.

Radio-collars were programmed to record six locations per day at 4-hour intervals starting at midnight. Data are uploaded via satellite each day at approximately 0800 Pacific Standard Time. Radio-collars were programmed to be automatically released from the animal in November 2022. Figure 6-11 shows the capture locations and overall distribution of mule deer and pronghorn from capture through December 31st, 2019. Mule deer were concentrated in the mid-elevation, mountainous regions while pronghorn were concentrated in Frenchman Flat and Yucca Flat. No long distance migration events were recorded during

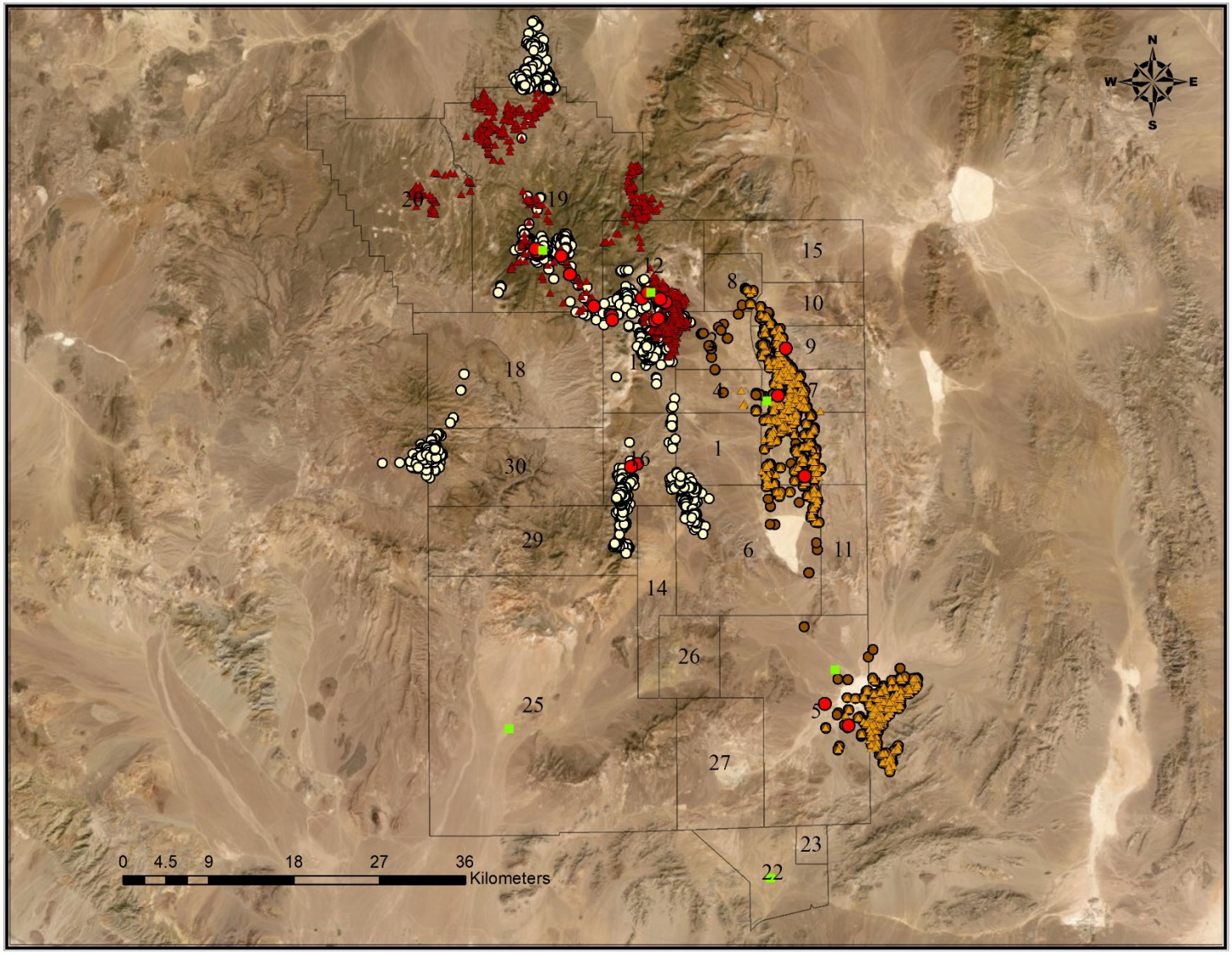

Figure 6-11. Staging areas (green square), capture locations (red circle) and mule deer (rust triangle = buck, cream circle = doe) and pronghorn antelope (orange triangle = buck, brown circle = doe) distribution, November – December 2019.

Figure 6-12. Processing captured pronghorn antelope at the Area 5, Frenchman Flat staging area.

(Photo by K.A. Rempe, November 15, 2019)

Figure 6-13. Radio-collared and ear-tagged mule deer buck soon after release, Echo Peak area.

(Photo by K.A. Rempe, November 16, 2019)

Table 6-4. Mule deer and pronghorn antelope capture information, November 15-17, 2019.

Collar ID	Species	Date	Where Processed	Capture Location	Age	Sex	Weight (lbs)	Body Score	Neck circumference (cm)	Dosimeter
705925	Mule Deer	11/15/2019	Area 12 Staging	Eleana Range, east of Staging Area	old	Female	135.5	3	36.5	Yes
705922	Mule Deer	11/15/2019	Area 12 Staging	Eleana Range, north of Captain Jack Spring	adult	Female	137	3	39.5	Yes
705931	Mule Deer	11/15/2019	Area 12 Staging	ER 12-1 Sump	2.5	Female	116	3	33.5	Yes
705938	Mule Deer	11/15/2019	Area 12 Staging	Near Road above V Tunnel	4	Female	149	3	35.5	Yes
705935	Mule Deer	11/15/2019	Area 12 Staging	Southwest slope of Rainier Mesa	old	Female	140	2	34.5	Yes
705933	Mule Deer	11/15/2019	Area 12 Staging	Southwest slope of Rainier Mesa	adult	Female	133	2.5	32.5	Yes
705955	Mule Deer	11/15/2019	Area 12 Field	ER 12-1 Sump	old	Male	Not taken	Not taken	Not taken	No
705960	Mule Deer	11/15/2019	Area 12 Field	Eleana Range, north of Captain Jack Spring	4	Male	Not taken	Not taken	Not taken	No
705923	Mule Deer	11/15/2019	Area 12 Field	Eleana Range Crest, north of Captain Jack Spring	mature	Male	Not taken	Not taken	Not taken	No
705932	Mule Deer	11/15/2019	Area 12 Field	Eleana Range, southwest of Captain Jack Spring	mature	Female	Not taken	Not taken	Not taken	Yes
705956	Mule Deer	11/15/2019	Area 12 Field	Eleana Range, south of Captain Jack Spring	old	Male	Not taken	Not taken	Not taken	No
705936	Mule Deer	11/16/2019	Area 19 Staging	North Big Burn Valley	4	Female	135	2.5	Not taken	Yes
705954	Mule Deer	11/16/2019	Area 19 Staging	Echo Peak I Road Meadow	adult	Male	>220	2	Not taken	No
705924	Mule Deer	11/16/2019	Area 19 Staging	Echo Peak I Road Meadow	2-3	Female	121	2.5	34	Yes
705937	Mule Deer	11/16/2019	Area 19 Staging	Echo Peak I Road Meadow	adult	Female	134	3	38	Yes
705940	Mule Deer	11/16/2019	Area 19 Field	Echo Peak I Road Meadow	mature	Female	Not taken	Not taken	Not taken	Yes
705929	Mule Deer	11/16/2019	Area 19 Field	Echo Peak I Road Meadow	old	Female	Not taken	Not taken	Not taken	Yes
705959	Mule Deer	11/16/2019	Area 19 Field	Echo Peak I Road Meadow	3	Male	Not taken	Not taken	Not taken	No
705958	Mule Deer	11/16/2019	Area 19 Field	Pahute Mesa Road, north of Camp 17 Pond	old	Male	Not taken	Not taken	Not taken	No
705939	Mule Deer	11/16/2019	Area 19 Field	Back Mesa Road, east of Rattlesnake Ridge	mature	Female	Not taken	Not taken	Not taken	No
705934	Mule Deer	11/16/2019	Area 19 Field	Echo Peak I Road Meadow	2	Female	Not taken	Not taken	Not taken	No
705951	Mule Deer	11/17/2019	Shoshone Mt Field	Shoshone Mt, northwest of 16A Tunnel	mature	Female	Not taken	Not taken	Not taken	No
705945	Mule Deer	11/17/2019	Shoshone Mt Field	Shoshone Mt, northwest of 16A Tunnel	old	Female	Not taken	Not taken	Not taken	No
705943	Pronghorn	11/15/2019	Frenchman Flat Staging	East of FACE Facility	adult	Female	115.5	3	Not taken	Yes
705963	Pronghorn	11/15/2019	Frenchman Flat Staging	East of FACE Facility	adult	Male	110.8	2.5	Not taken	Yes
705965	Pronghorn	11/15/2019	Frenchman Flat Staging	East of FACE Facility	3.5	Male	117.5	2.5	Not taken	Yes
705947	Pronghorn	11/15/2019	Frenchman Flat Staging	Southwest of Well 5B	adult	Female	107	2.5	Not taken	Yes
705949	Pronghorn	11/15/2019	Frenchman Flat Staging	Southwest of Well 5B	older	Female	128	2.5	Not taken	Yes
705946	Pronghorn	11/15/2019	Yucca Flat Staging	West of Orange Blossom Road	2.5	Female	108	3	38.5	Yes
705942	Pronghorn	11/15/2019	Yucca Flat Staging	West of Orange Blossom Road	4	Female	116	2.5	35.5	Yes
705953	Pronghorn	11/15/2019	Yucca Flat Staging	West of Orange Blossom Road	3	Female	102	3	38	Yes
705967	Pronghorn	11/15/2019	Yucca Flat Field	West of Orange Blossom Road	3	Male	Not taken	Not taken	Not taken	Yes
705961	Pronghorn	11/15/2019	Yucca Flat Field	West of Orange Blossom Road	3	Male	Not taken	Not taken	Not taken	Yes
694710	Pronghorn	11/17/2019	Yucca Flat Staging	East of Ice Cap	6 to 7	Female	Not taken	3	Not taken	No
705948	Pronghorn	11/17/2019	Yucca Flat Staging	East of Ice Cap	3	Female	113	3	36.5	No
705964	Pronghorn	11/17/2019	Yucca Flat Staging	East of Ice Cap	adult	Male	121	2.5	Not taken	No
705941	Pronghorn	11/17/2019	Yucca Flat Staging	East of Ice Cap	adult	Female	109	2.5	32	Yes
705927	Pronghorn	11/17/2019	Yucca Flat Staging	Northeast Yucca Flat, Area 9	adult	Female	101	3	34.5	No
705962	Pronghorn	11/17/2019	Yucca Flat Staging	Northeast Yucca Flat, Area 9	3.5	Male	134	3	45.5	No
705944	Pronghorn	11/17/2019	Yucca Flat Field	East of Ice Cap	3	Female	Not taken	Not taken	Not taken	No
705970	Pronghorn	11/15/2019	Yucca Flat Staging	West of Orange Blossom Road	adult	Female	104	2.5	33.5	Yes
Not collared	Pronghorn	11/17/2019	Yucca Flat Staging	Northeast Yucca Flat, Area 9	2	Female	105	2	35	No
Died at staging area	Pronghorn	11/15/2019	Frenchman Flat Staging	Southwest of Well 5B	Yearling	Female	109.5	3	Not taken	No

this time period. There were some movements of mule deer onto the Nevada Test and Training Range (NTTR) north of Pahute Mesa and west of Timber Mountain, and some pronghorn moved onto NTTR east of Frenchman Flat.

Two mortalities were documented after the captures. Two pronghorn does were killed/scavenged by coyotes within a couple of days of being captured. One doe (#705970) died around 0800 on November 19th. The carcass was found on the Yucca Playa lakebed and the collar was found nearly 500 m west of the carcass but still on the lakebed. This animal traveled a long distance to Frenchman Flat east of the dry lakebed and back to Yucca Flat within 24 hours of dying, a distance of about 40 km. The other doe (#705944) had been mistakenly captured twice. It died around 1600 hours on November 19th and was found within 1.9 km of #705970.

Blood samples for 14 of the 23 mule deer and 18 of the 20 pronghorn were sent by NDOW to the Washington Animal Disease Diagnostic Lab where they were tested for Anaplasmosis (ELISA test), Bluetongue (ELISA test), Bovine Respiratory Syncytial Virus (BRSV) (Virus Neutralization), Parainfluenza Virus (PI-3) (Virus Neutralization), and Epizootic Hemorrhagic Disease (EHD) (ELISA test). Five mule deer tested positive for Anaplasmosis and one mule deer tested positive for PI-3. No mule deer were positive for Bluetongue, BRSV or EHD. Four pronghorn tested positive for bluetongue and four for EHD. No pronghorn were positive for Anaplasmosis, BRSV, or PI-3.

6.6 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 a comprehensive USGS Open File Report on the study is being finalized for publication. Conclusions from the radio-tracking study recommend continued monitoring of the NNSS sheep population. In 2019, this was done by documenting sheep use at several water sources using camera traps. Also, at the end of the radio-tracking study, three animals (2 rams, 1 ewe) still had the radio-collars attached due to an error during capture in which excess collar material was not cut off. In January and February attempts were made to track these animals and assess the collar status. Only one animal was observed (Ram 686328) and appeared to be fine. It was in the Beatty Wash area with several other rams (Figure 6-14).

6.6.1 Camera Trap Results

During 2019, motion-activated cameras detected sheep at Delirium Canyon Tanks (820 images), Cottonwood Spring (365 images), Twin Spring (107 images), Fortymile Canyon Tanks (46 images), South Pah Canyon Tanks (11 images) (Table 6-5). A minimum of 15 individual sheep were detected at Fortymile Canyon Tanks. These included 5 marked sheep (Ewe 686318; Ewe 686314; Ewe 686318; Ewe I, E, or 120; and Ram 116 with collar) and 10 unmarked sheep (4 ewes, 2 lambs, 1 young ram, and 3 adult rams). At Cottonwood Spring, a minimum of 14 individual sheep were detected including 9 marked sheep (Ewe 686317, Ewe 686319 [Figure 6-15], Ewe 686318, Ewe 686315, Ewe 686320, Ewe 686314, Ram 123, Ram J 686326, and Ram 686327) and 5 unmarked sheep (3 ewes, 1 young ram, 1 adult ram). Five marked sheep were detected at Delirium Canyon Tanks including Ewe 686316 with collar, Ewe 686318, Ewe 686319, Ewe 686313, and Ram 686328 as well as at least four unmarked adult ewes, one young ewe, and one young ram for a total of at least 11 individuals. A minimum of 4 individuals were detected at South Pah Canyon Tanks. These included 1 marked ewe (Ewe 686313) and 3 unmarked sheep (1 adult

ewe, 1 lamb, 1 young ram). Only rams were detected at Twin Spring including 3 marked rams (Ram 686328, Ram116 with collar, and Ram J 686326) and 2 unmarked rams (1 young ram and 1 adult ram).

Similar to 2017 and 2018, a total of 13 marked sheep were documented with camera traps at water sources. These included 8 ewes (6 captured in 2016 and 2 captured in 2015) and 5 rams (4 captured in 2016 and 1 captured in 2015). In addition to the 13 marked sheep, a minimum of 11 unmarked sheep (4 adult ewes, 1 young ewe, 2 lambs, 3 adult rams, and 1 young ram) were also detected at the monitored water sources. Combined, a minimum of 24 sheep were documented at monitored water sources on the NNSS in 2019. Two sheep, Ewe 686316 and Ram 686328, still had the radio-collars attached.

Figure 6-14. Collared Ram 686328 (center-left) with ten other rams, hills west of Yucca Mountain.

(Photo taken January 31, 2019 by D.B. Hall)

Figure 6-15. Ewe 686319 (upper) and unmarked ewe (lower) at Cottonwood Spring.

(Photo taken November 18, 2019 by motion-activated camera)

6.7 MOUNTAIN LION MONITORING

6.7.1 Motion-Activated Cameras

Few data exist for mountain lion numbers and their distribution in southern Nevada, including the NNSS. Since 2006, site 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 2019 at 25 sites (Figure 6-16 and Table 6-5). 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 2018 and early 2020 due to the accessibility and scheduling of camera trap visits. Images for all locations, except Delirium Canyon Tanks, from December 2019 through early May 2020 were lost due to a computer hard drive issue.

A total of 69 mountain lion images (i.e., photographs or video clips) were taken during 112,428 camera hours across all sites (Figure 6-16 and Table 6-5). This equates to about 0.6 mountain lion images per 1,000 camera hours. Mountain lions were detected at seven of the 25 sites, including five water sources, one canyon, and one road (Figure 6-16). Table 6-6 contains the camera trap results by month and location. Figure 6-17 depicts two mountain lions at Fortymile Canyon Tanks.

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 three individuals (adult male, adult female with

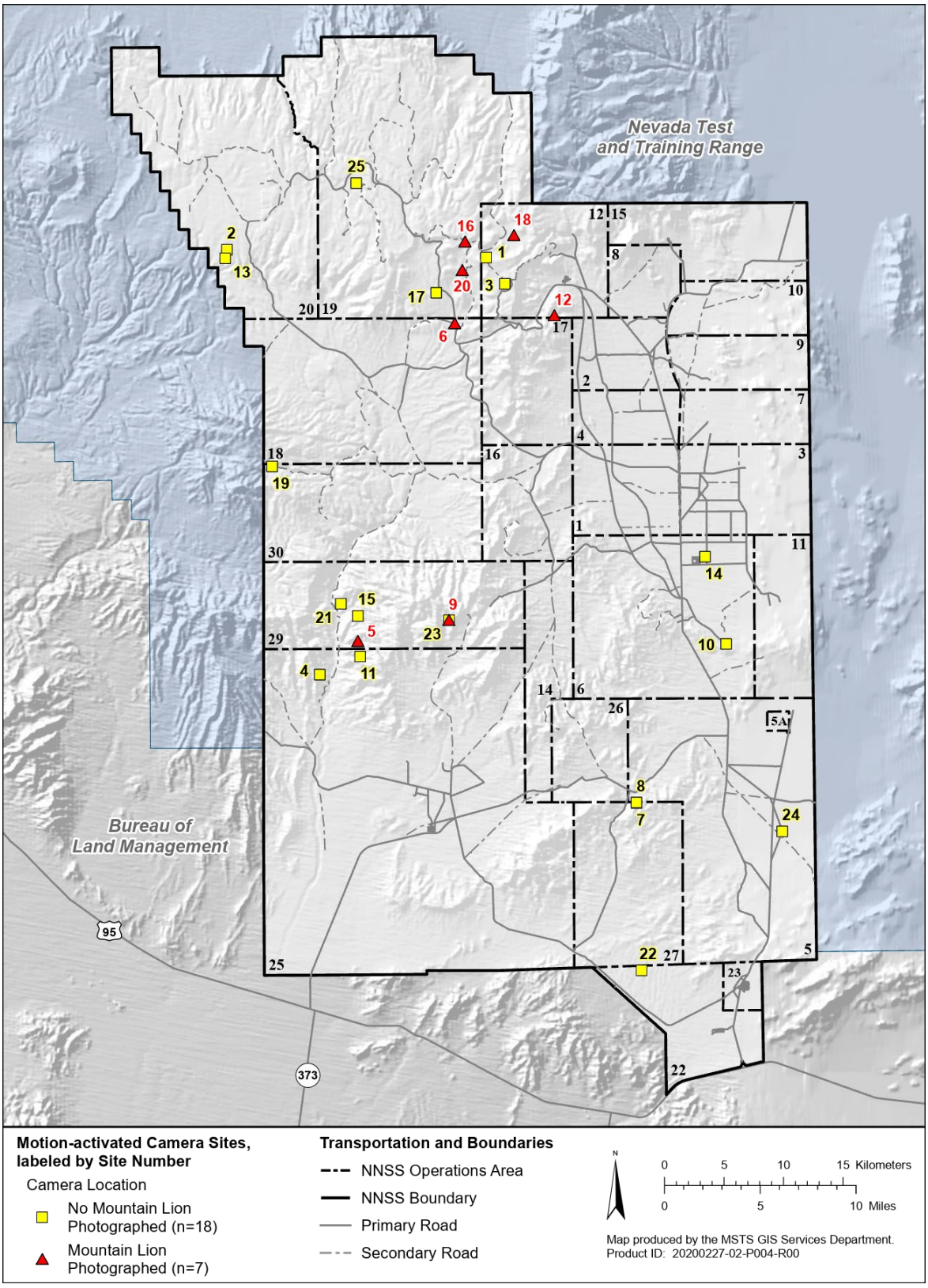

Figure 6-16. Locations of mountain lion photographic detections and camera traps on the NNSS during 2019.

Table 6-5. Results of mountain lion camera surveys during 2019 (a = non-continuous operation due to camera problems, dead batteries, full memory cards, etc.; b = camera hours not known for some time periods)

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Captain Jack Spring (#12)	5/7-12/16/19[a]	3,096	29 (9.4)	Bobcat (2), coyote (15), mule deer (1,166), desert cottontail (2), Cooper's hawk (1), chukar (1), mourning dove (10), pinyon jay (1), common raven (1)
Camp 17 Pond (#6)	5/7-12/16/19[a]	2,018	6 (3.0)	Bobcat (1), coyote (104), mule deer (1,573), horse (338), black-tailed jackrabbit (1), golden eagle (12), white-faced ibis (1), Cooper's hawk (79), red-tailed hawk (83), turkey vulture (52), black-necked stilt (10), belted kingfisher (5), red-shafted common flicker (3), chukar (39), mourning dove (178), common raven (430), house finch (17), American robin (1), owl (3), shorebird (1), ducks (8), rock dove (1)
Topopah Spring (#9)	5/8-12/17/19	5,352	13 (2.4)	Bobcat (8), coyote (2), pronghorn antelope (1), mule deer (10)
Rattlesnake Ridge Gorge (#20)	5/7/19-1/1/20[a]	4,157	9 (2.2)	Mourning dove (5)
East 19-01 Road (#16)	5/7/19-1/1/20[a]	4,029	4 (1.0)	Bobcat (3), gray fox (3), coyote (10), mule deer (6) black-tailed jackrabbit (34), hawk (1), jay (1)
Gold Meadows Spring (#18)	5/7/19-1/1/20[a]	3,826	4 (1.0)	Coyote (8), Rocky Mountain elk (6), pronghorn antelope (42), mule deer (72), horse (75), golden eagle (2), turkey vulture (29), common raven (13)
Delirium Canyon (#5)	1/22/19-1/16/20	8,615	4 (0.5)	Bobcat (7), gray fox (71), ring-tailed cat (6), coyote (12), spotted skunk (3), desert bighorn sheep (820), rock squirrel (21), cliff chipmunk (2), bats (8), golden eagle (2), turkey vulture (3), chukar (4) mourning dove (1,677), indigo bunting (1), hawk (106), flycatcher (6)
12T-26, Rainier Mesa (#1)	5/7/19-1/1/20	5,737	0 (0.0)	Coyote (1), mule deer (3)

Table 6-5. Results of mountain lion camera surveys during 2019 (continued).

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Dick Adams Cutoff Road, Rainier Mesa (#3)	5/7-12/17/19	5,376	0 (0.0)	Mule deer (54), rock squirrel (1)
Water Bottle Canyon (#17)	5/7-12/17/19	5,375	0 (0.0)	None
East Cat Canyon (#19)	5/7-12/16/19	5,351	0 (0.0)	Mule deer (28)
Topopah Spring Trough (#23)	5/8-12/17/19	5,352	0 (0.0)	Mule deer (19)
Area 22, Juvenile GOAG Site 2 (#22)	5/6/19-1/7/20[a]	5,734	0 (0.0)	Kit fox (4), badger (2), black-tailed jackrabbit (18), white-tailed antelope ground squirrel (14), LeConte's thrasher (3), mourning dove (1), horned lark (1), desert tortoise (1), leopard lizard (7), zebra-tailed lizard (6)
Twin Spring (#21)	5/15/19-1/16/20[a]	965	0 (0.0)	Bobcat (4), gray fox (9), coyote (21), desert bighorn sheep (107), mule deer (1,386), burro (1,375), golden eagle (11), Cooper's hawk (3), chukar (1,274), mourning dove (30), pinyon jay (41), common raven (18), house finch (1)
South Pah Canyon (#15)	5/13/19-1/16/20[a]	2,950	0 (0.0)	Desert bighorn sheep (11), mourning dove (178), hummingbird (1)
Fortymile Canyon Tanks (#11)	5/16/19-1/16/20	5,878	0 (0.0)	Bobcat (1), gray fox (5), coyote (1), desert bighorn sheep (46), chukar (1), mourning dove (20)
Cottonwood Spring (#4)	5/15/19-1/16/20[a]	2,589	0 (0.0)	Bobcat (2), gray fox (18), coyote (24), desert bighorn sheep (365), mule deer (9), bats (28), chukar (6), mourning dove (42), loggerhead shrike (3), common raven (4), house finch (1,581), desert spiny lizard (26)
Cane Spring (#7)	9/10-12/17/19	2,356	0 (0.0)	Mule deer (7)

Table 6-5. Results of mountain lion camera surveys during 2019 (continued).

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Cane Spring Trough (#8)	5/1-12/17/19	5,522	0 (0.0)	Mule deer (1), mourning dove (12), common raven (4)
Area 6 LANL Pond Trough (#14)	5/1-12/16/19	5,493	0 (0.0)	Pronghorn antelope (5), turkey vulture (1), mourning dove (2)
Well C1 Pond Trough (#10)	5/1-12/16/19	5,493	0 (0.0)	Bobcat (1), coyote (18), pronghorn antelope (4), mule deer (40), burro (99), turkey vulture (18), chukar (3), mourning dove (95), common raven (26)
Well 5C Trough (#24)	5/1-12/16/19[a]	4,150	0 (0.0)	Bobcat (2), coyote (127), pronghorn antelope (726), burro (630), black-tailed jackrabbit (108), white-tailed antelope ground squirrel (1), Cooper's hawk (2), great-horned owl (3), turkey vulture (10), greater roadrunner (1), mourning dove (3,765), loggerhead shrike (5), common raven (368), yellow-headed blackbird (5), horned lark (1), brown-headed cowbird (27)
ER 20-5 Upper Plastic-lined Sump (#2)	9/11-12/16/19	2,307	0 (0.0)	Passerine (6)
U19ad Plastic-lined Sump (#25)[b]	5/7-12/16/19	5,354	0 (0.0)	Unknown bird (1)
ER 20-7 Plastic-lined Sump (#13)	5/7-12/16/19	5,353	0 (0.0)	Chukar (1), mourning dove (3), common raven (11), Say's phoebe (1)

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

Camera Location (Site number)	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
Delirium Canyon (#5)						4							
Topopah Spring (#9)											13		
Captain Jack Spring (#12)							1				18	10	
Rattlesnake Ridge Gorge (#20)							3	3		2	1		
Camp 17 Pond (#6)										2	4		
East 19-01 Road (#16)							1			2	1		
Gold Meadows Spring (#18)							3			1			

Figure 6-17. Two mountain lions at Delirium Canyon Tanks.

(Photo taken May 1, 2019, by motion-activated camera)

subadult) were documented in 2019 from the 25 camera traps. A camera trap from another project documented an adult female and three subadult cubs at E Tunnel Ponds. This makes a total of at least five individuals (adult male, adult female, 3 subadults) known to occur on the NNSS in 2019. This compares to a minimum of three individuals in 2018, four individuals in 2017, five individuals in 2016, three individuals in 2015 and four individuals in both 2014 and 2013. An adult mountain lion was also observed at E Tunnel Ponds on October 8 during mule deer spotlight surveys.

In order to investigate temporal activity of mountain lions, camera detection data from all 14 years (2006–2019) were combined. Mountain lions were detected every month with peak occurrences during June, (n = 110), August (n = 102) and November (n = 147) (Figure 6-18). The number of images taken during summer and fall (June–November) (n = 593) accounted for nearly two-thirds of all images compared with the number of images taken during winter and spring (December–May) (n = 295) (Figure 6-18). Nearly three-fourths of mountain lion images were taken between 1700 to 0500 hours (Figure 6-19). From 2011 to 2019, nearly 1.6 times as many images were taken when it was dark (n = 429) compared with when it was light (n = 270).

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 20,175 images of at least 52 species other than mountain lions were taken during 112,428 camera hours across all sites (Table 6-5) which is about 179 images per 1,000 camera hours. This is the greatest species richness documented using camera traps in a given year and the highest number of images per 1000 camera hours by more than three-fold, and this in spite of the fact that little data was collected from January to early May.

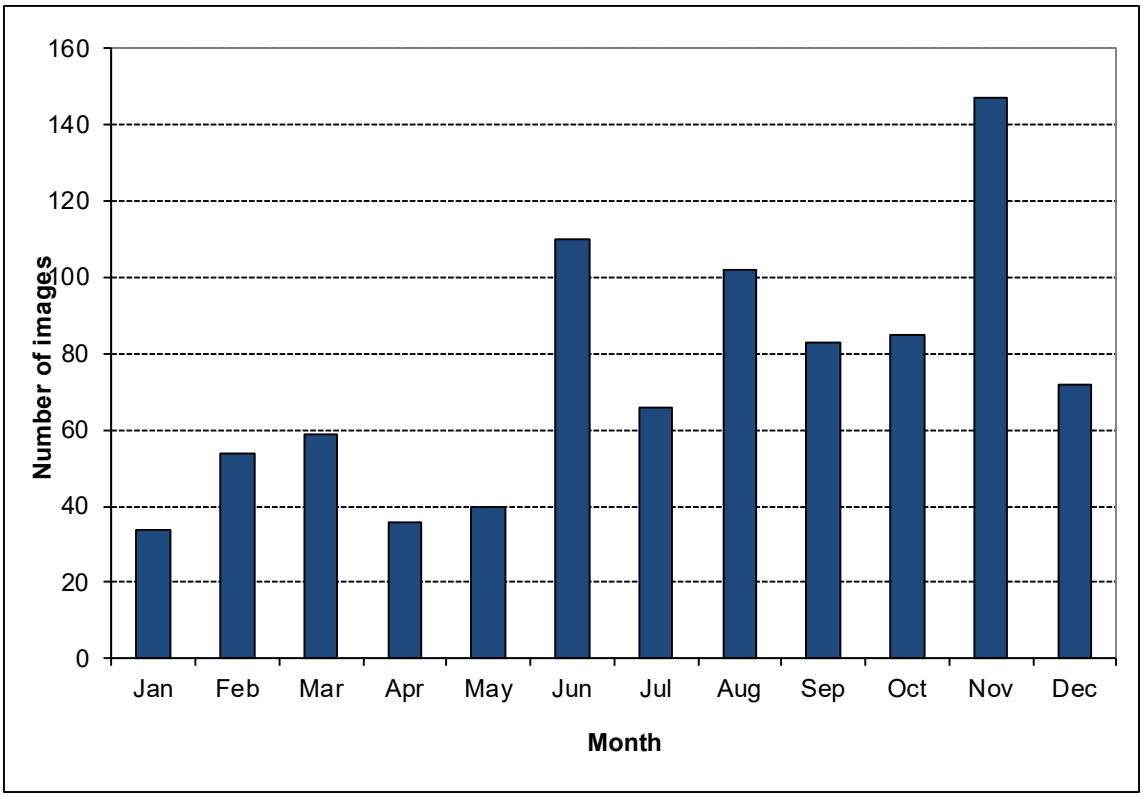

Figure 6-18. Number of mountain lion images by month for camera sites where mountain lions were detected from 2006 through 2019 (n = 888).

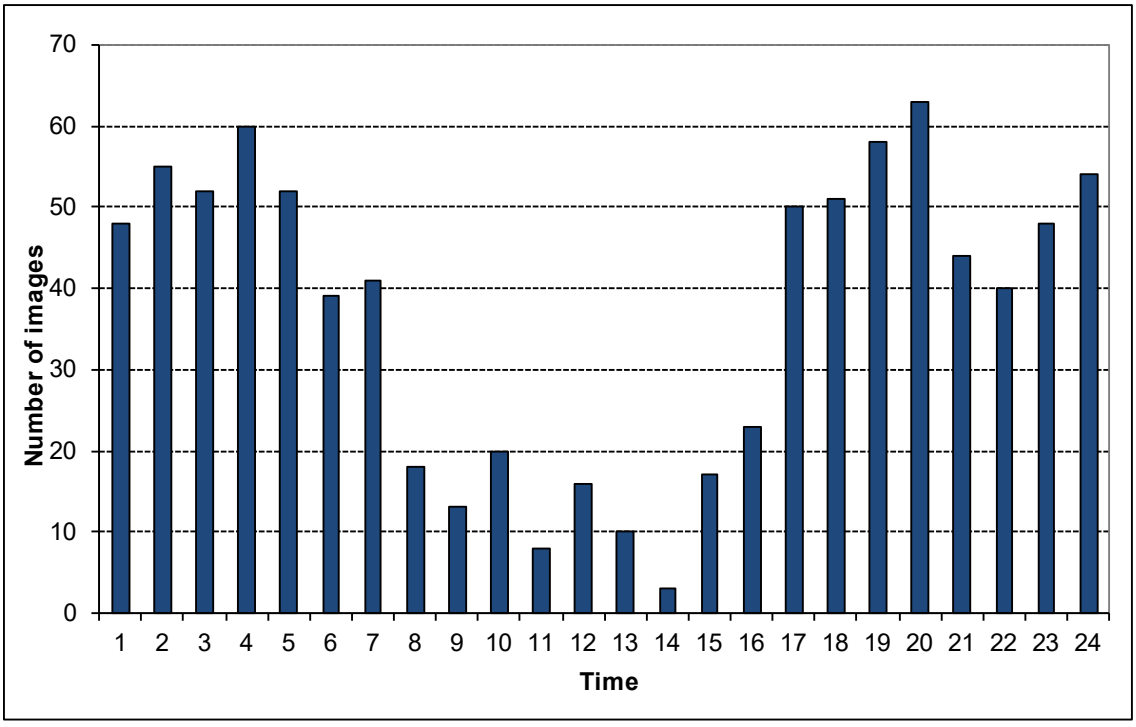

Figure 6-19. Number of mountain lion images by time of day (Pacific Standard Time) for camera sites where mountain lions were detected from 2006 through 2019 (n = 883).

The most prevalent species photographed (22% of all images) was mule deer (4,372 images at 14 of 25 sites). Captain Jack Spring (1,166 images), Camp 17 Pond (1,573 images), and Twin Spring (1,386 images) are very important water sources for mule deer. Some of the rarer, more elusive species documented from camera surveys were desert bighorn sheep (see Section 6.7.1), bobcat (found at 10 of 25 sites), gray fox (found at 5 of 25 sites), golden eagle (found at 4 of 25 sites), and badger (found at 1 of 25 sites). Kit fox, LeConte's thrasher (*Toxostoma lecontei*) and desert tortoise were documented at the Area 22, Juvenile GOAG Site 2 location. Noteworthy observations of some of the more common species included 343 images of coyotes at 11 of 25 sites and 875 images of common ravens at 9 of 25 sites. Greatest use and highest species richness was 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.

6.8 RADIOLOGICAL SAMPLING

Sampling for radionuclides in game species (e.g., mule deer, pronghorn antelope) was performed in order 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. 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 2019, four tissue samples were collected opportunistically and analyzed, from one dead adult female bobcat and three roadkill antelope (one adult female and two adult males). In addition, tissue samples were taken from two captured antelope including a yearling female that died at the staging area and an adult female that died a few days after capture from coyote predation. Further, blood samples were taken from 20 captured antelope and 21 captured mule deer. 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. Blood samples were analyzed for tritium and gamma-emitting radionuclides and 10 mule deer and 10 antelope samples were also analyzed for Strontium-90, Plutonium-238, Plutonium-239+240, and Americium-241.

Results revealed very low radionuclide concentrations as follows: Americium-241 in one of the road-killed antelope, tritium in 85.7% of mule deer samples and in 65% of the antelope samples, Strontium-90 in two antelope and one mule deer, and Plutonium 239-240 in two mule deer and one antelope. All of these concentrations are 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 (2020).

6.9 NUISANCE AND POTENTIALLY DANGEROUS WILDLIFE

During 2019, MSTS biologists documented 40 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 (21 calls), bats (4 calls), other mammals (7 calls), reptiles (6 calls, including 2 rattlesnakes), and invertebrates (bees, 1 call; spiders 1 call). 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.

6.10 ELK AND FERAL BURROS

Historic studies on the NNSS do not mention the presence of Rocky Mountain elk (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 young bulls is to the north, possibly in the Groom or Kawich Range. During 2019, elk were photographed at Gold Meadows Spring six times between May 9 and August 9. Two elk were observed in the Gold Meadows area during feral horse surveys on June 11. One mature bull elk was photographed 52 times between September 13-15 at E Tunnel Ponds.

Feral burros appear to be increasing in number and expanding their range on the NNSS. During 2019, burros were documented with camera traps at Twin Spring (1,375 images), Well 5C trough (630 images) and Well C1 Pond Trough (99 images) (Table 6-5). The area around Twin Spring was heavily disturbed from burro use with numerous trails on the hillslope around the spring. All burro photos at Twin Spring were taken in November, and numerous photos showed burros at the spring with mule deer and desert bighorn sheep.

6.11 COORDINATION WITH BIOLOGISTS AND WILDLIFE AGENCIES

Site biologists interfaced with other biologists and wildlife agencies in 2019 for the following activities:

- Published an article entitled, “Western Red-tailed Skink (*Plestiodon gilberti rubricaudatus*) Distribution and Habitat Use in Southern Nevada, USA” in Herpotological Conservation and Biology (Hall et al. 2019).

- Gave a presentation entitled “How Desert Bighorn Sheep are Repatriating the Nevada National Security Site” at the 2019 Desert Bighorn Council Meeting in Mesquite, Nevada. A follow-up manuscript entitled “Repatriated Desert Bighorn Sheep Population on the Nevada National Security Site” was written and submitted for publication in the Desert Bighorn Council Transactions.

- Gave presentation entitled, “Ecology of an Unexploited Population of Mountain Lions Living in one of the Driest Places in North America” at the American Fisheries Society and The Wildlife Society 2019 Joint Annual Conference in Reno, Nevada.

- Crew leader and volunteer at the annual Bat Blitz for the Nevada Bat Working Group in southern Nevada in May.

- Contributed to the draft version of the Nevada Bat Conservation Plan.

- Attended Partners-in-Flight meeting at Corn Creek, Nevada in July.

- Assisted with a bird banding study at Moapa National Wildlife Refuge.
- Participated on the Springsnail Conservation Team and facilitated the signing of the Conservation Agreement for Springsnails in Nevada and Utah by NNSA/NFO.
- Retrieved a desert bighorn sheep ram head and collar from Quartz Mountain (NTTR) for NDOW biologists.

7.0 HABITAT RESTORATION MONITORING

MSTS biologists have conducted revegetation activities at disturbances on and off the NNSS in support of NNSA/NFO and DOE Environmental Management Nevada Program activities and continue to evaluate those efforts. Revegetation supports the intent of Executive Order EO 13112, "Invasive Species," to prevent the introduction and spread of non-native species and restore native species to disturbed sites. Revegetation also may qualify as mitigation for the loss of desert tortoise habitat under the current Opinion. Activities conducted in 2019 included visually assessing the vegetation at the U-3ax/bl closure cover (CAU 110) and the "92-Acre Site" (CAU 111), overseeing and supporting the revegetation of Clean Slate II and Clean Slate III sites on the Tonopah Test Range, and preparing for the revegetation of Cell 18 at the Area 5 RWMC.

7.1 CORRECTIVE ACTION UNIT (CAU) 110, U-3AX/BL, CLOSURE COVER

A qualitative assessment of the vegetation on CAU 110, U3-ax/bl closure cover was made on September 4, 2019. A meandering transect covering the entire cap was walked. The vigor of perennial plant species was assessed based on current year's growth, whether plants were flowering, and if any showed signs of stress, i.e. dead stems or leaves. Shadscale (*Atriplex confertifolia*) continues to be the most abundant shrub species on the closure cover (Figure 7-1). None of the plants observed showed signs of stress, however some dead shadscale plants were noted. Flowering plants were uncommon because of the time of sampling. However, most of the shadscale plants were fruiting and had good seed production. There was evidence of good seed production for Nevada jointfir, the second most common perennial species, as well. The other shrubs occasionally encountered on the closure cover were winterfat and fourwing saltbush. 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. Surprisingly, with the above-average precipitation, annual plant cover was quite low with Esteve's pincushion (*Chaenactis stevioides*) the most dominant annual. Bristly fiddleneck (*Amsinckia tessellata*) and flatcrown buckwheat (*Eriogonum deflexum*) were also observed in low numbers. Invasive species were minimal on the seeded portion of the cover cap with cheatgrass and saltlover (*Halogeton glomeratus*) observed.

During the vegetation surveys, small mammal activity on the CAU 110, U-3ax/bl closure cover was evaluated. Several burrow complexes were noted but not counted. There was activity around a few of the burrow entrances but many were not active. The number of burrows on the cover cap is far less than in the native undisturbed areas in Yucca Flat. The small mammal activity on the closure cover appeared to be about the same as last year. Trapping of small mammals is not recommended at this time. No rabbits were observed or evidence of herbivory on the vegetation.

In summary, the vegetative cover on the CAU 110, U-3ax/bl cover cap appears to be stable and in very good condition. The plants on the cap showed good growth this year with many producing seed because of the increase in precipitation. Some dead shadscale plants were observed but this is to be expected as the plant community matures and due to the drought a few years ago. No perennial plant seedlings were observed which might be an issue. The annual forb component of the plant community was surprisingly low this year considering the above-normal precipitation. The area surrounding the cover which was not seeded continues to be covered with noxious weeds, primarily saltlover which highlights the importance of seeding to establish a perennial plant community.

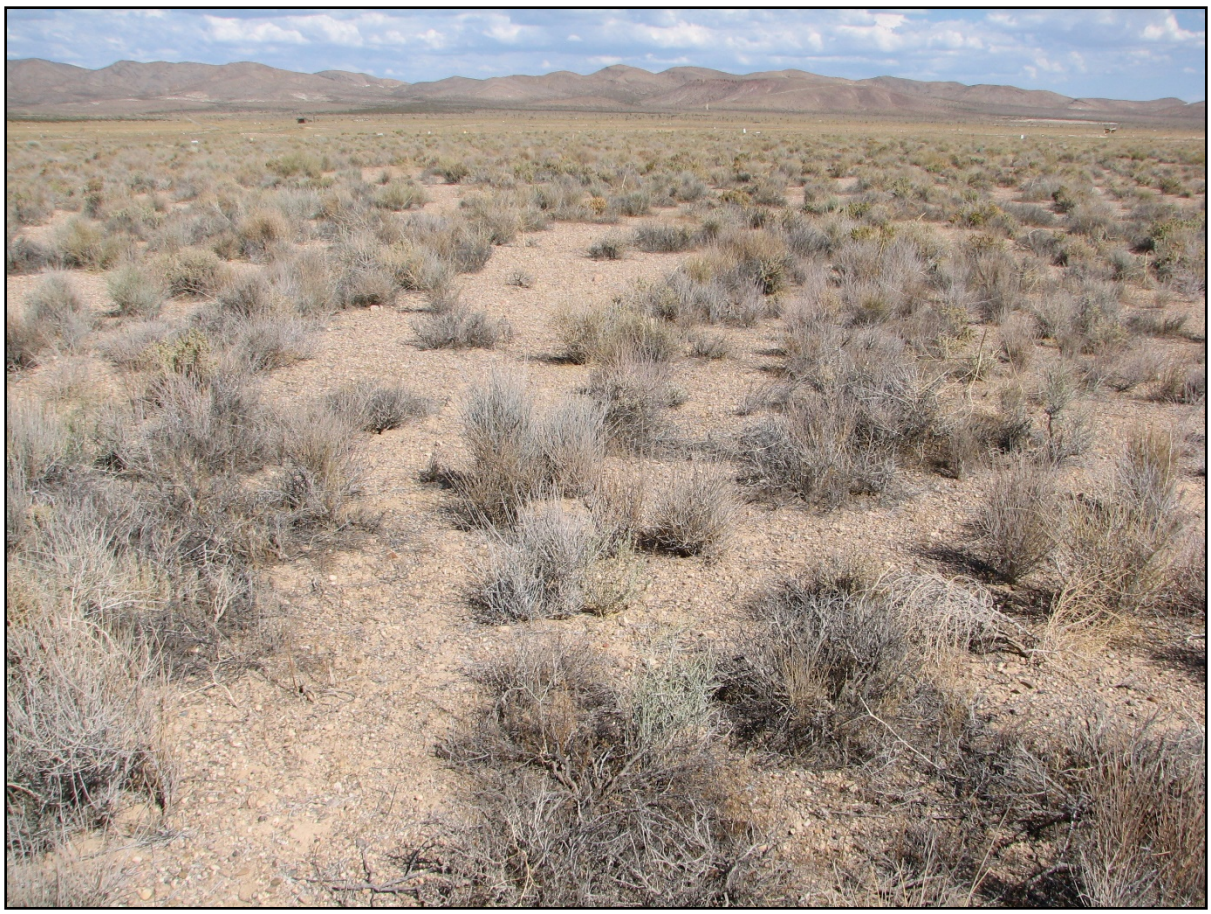

Figure 7-1. Plant community that has established on the U3ax/bl cover cap with shadscale and Nevada jointfir being the dominant species.

(Photo taken September 4, 2019 by D.B. Hall)

7.2 CAU 111, "92-ACRE SITE," CLOSURE COVERS

A qualitative assessment of vegetation at the 92-acre site on September 4 found very few perennial plants on any of the cover caps. There were about 20 large fourwing saltbush plants on the North South Cover. These plants were from the prior revegetation efforts that had survived the extensive rabbit herbivory before the site was fenced.

Overall the integrity of the cover caps was very good. Weed densities were pretty high due to the abundant precipitation earlier in the spring and early summer with saltlover, Arabian schismus, and prickly Russian thistle (*Salsola tragus*) being the most common species (Figure 7-2). No rabbits or fresh rabbit sign were observed. Light rodent burrowing activity was detected.

Several badger burrows were noted near the tribal revegetation plots in January. Most of the burrowing was around the existing large fourwing saltbush plants (Figure 7-3). The badger may have been trying to dig up rodents that had burrowed under the plants. During the September check no new badger burrows were found.

Figure 7-2. West Cover on the "92-acre Site" with an abundance of weeds, primarily saltlover and Arabian schismus.

(Photo taken September 4, 2019 by D.B. Hall)

Figure 7-3. Badger burrow at the base of a fourwing saltbush plant, North South Cover, "92-acre site."

(Photo taken January 9, 2019 by D.B. Hall)

7.3 CLEAN SLATE II (CAU 413) AND CLEAN SLATE III (CAU 414) REVEGETATION

At the request of Navarro Research and Engineering, Inc., MSTS biologists provided input to a revegetation plan for the Clean Slate II (CAU 413) and Clean Slate III (CAU 414) cleanup sites on TTR during 2019 (Navarro 2019). MSTS biologists were also involved in site preparation and seeding activities. Due to a limited budget and constraints working inside a radiologically contaminated area, the original revegetation plans for these two sites (Anderson and Hall 1997, Hall and Anderson 1999) were revised and only included ripping the areas to be seeded, broadcast seeding a tailored mix of native seeds (Table 7-1) using a drill seeder, and then irrigating with a water truck.

Site preparation and seeding occurred during the fall and early winter. After an area was seeded, irrigation was applied using a water truck. Revegetation monitoring to evaluate seeding success is planned for summer of 2020.

Table 7-1. Seedmix used at the Clean Slate II and Clean Slate III cleanup sites.

Plant Type	Scientific Name	Common Name	PLS lbs/acre	Seeds/M2
Shrub	*Atriplex canescens*	Fourwing Saltbush	4.0	**55**
	Atriplex confertifolia	Shadscale	7.5	**120**
	Ephedra nevadensis	Nevada Ephedra	5.0	**25**
	Ericameria nauseosa	Rubber Rabbitbrush	0.5	**86**
	Krascheninnikovia lanata	Winterfat	7.0	**213**
Grass	*Achnatherum hymenoides (Paloma)*	Indian Ricegrass	4.0	**160**
	Elymus elymoides	Squirreltail	1.0	**47**
	Pleuraphis jamesii	Galleta grass	4.0	**157**
Forb	*Sphaeralcea ambigua*	Globe Mallow	1.0	**124**
	TOTALS		**34.0**	**932**

7.4 AREA 5 RWMS, CELL 18 REVEGETATION PREPARATION

It is anticipated that Cell 18 at the Area 5 RWMS will be closed and revegetated during 2020. MSTS biologists will be working with a subcontractor to develop a revegetation plan and then overseeing the implementation of that plan. The revegetation strategy includes a combination of seeding and transplanting. There is evidence that suggests seed collected from local sources as close to the revegetation site as possible are best adapted to survive with a higher chance for successful establishment. Growing conditions during 2019 were favorable for seed production for several species. Multiple days were spent collecting white bursage, creosote bush, and Nevada jointfir seed. Seed was sent to a seed company for cleaning and testing. Some seed was given to the Nevada Division of Forestry who has the contract to grow 5000 transplants (2,500 white bursage, 2,500 creosote bush) and the remaining seed will be used in the seedmix to compare success from locally collected seed versus commercially available seed.

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9.0 *REFERENCES*

Anderson, D.C. and D.B. Hall. 1997. Clean Slate 2 Revegetation and Monitoring Plan. DOE/NV/11718-150 UC702. September 1997, Bechtel Nevada Ecological Services, Las Vegas, NV.

Baldwin, B.G, S. Boyd, B.J. Ertter, R.W. Patterson, T.J. Rosatti, and D.H. Wilken. 2012. *The Jepson Manual: Vascular Plants of California*. University of California Press, Berkeley, CA.

Beatley, J.C. 1977. Endangered Plant Species of the Nevada Test Site, Ash Meadows, and Central-Southern Nevada. Department of Biological Sciences University of Cincinnati. Cincinnati, OH.

Bechtel Nevada. 2001. Adaptive Management Plan for Sensitive Plant Species on the Nevada Test Site. Environmental Monitoring, Ecological Services, Las Vegas, NV. March 2001.

Bechtel Nevada. 2006. Ecological Monitoring and Compliance Program Calendar Year 2005 Report. Environmental Monitoring, Ecological Services, March 2006. Las Vegas, NV.

Blomquist, K.W., T.A. Lindemann, G.E. Lyon, D.C. Steen, C.A. Wills, S.A. Flick and W.K. Ostler. 1995. Current Distribution, Habitat, and Status of Category 2 Candidate Plant Species on and Near the U.S. Department of Energy's Nevada Test Site. EGG 11265-1149, UC-708. EG&G Energy Measurements, Las Vegas Area Operations, December 1995. Las Vegas, NV.

Brooks, M. and M. Lusk. 2008. Fire Management and Invasive Plants: A Handbook. U.S. Fish and Wildlife Service, Arlington, VA. 27 p.

Collins, E., T.P. O'Farrell, and W.A. Rhoads. 1982. Biologic Overview for the Nevada Nuclear Waste Storage Investigations, Nevada Test Site, Nye County, Nevada. EGG 1183-2460, EG&G Energy Measurements, January 1982. Santa Barbara, CA.

Conway, C.J., A. Macias-Duarte, V. Garcia, and C.A. Finley. 2010. Migratory linkages of burrowing owls on DoD installations and adjacent lands final report. 05-243, 06-243, 07-243, 08-243, 09-243, Department of Defense Legacy Program.

Cronquist, W., A.H. Holmgren, N.H. Holmgren, J.L. Reveal, P.K. Holmgren. 1984. Intermountain Flora; Vascular Plants of the Intermountain West, U.S.A. Volume Four. The New York Botanical Garden. Bronx, NY.

DOE, see U.S. Department of Energy.

DOE/NV, see U.S. Department of Energy, Nevada Operations Office.

E.O., see U.S. Executive Order.

FWS, see U.S. Fish and Wildlife Service.

Giles, K., and J. Cooper. 1985. Characteristics and Migration Patterns of Mule Deer on the Nevada Test Site. EPA 600/4-85-030. Environmental Protection Agency, Las Vegas, NV.

Greger, P.D. and D.B. Hall. 2009. Burrow occupancy patterns of the western burrowing owl in southern Nevada. Western North American Naturalist 69:285-294.

Hall, D.B. and D.C. Anderson. 1999. Clean Slate 3 Revegetation and Monitoring Plan. DOE/NV/11718-323. May 1999, Bechtel Nevada Ecological Services, Las Vegas, NV.

Hall, D.B., P.D. Greger, A.V. Cushman, and C.A. Wills. 2003. Ecology of the western burrowing owl on the Nevada Test Site. DOE/NV/11718-701, U.S. Department of Energy, Nevada Site Office, Las Vegas, NV.

Hall, D.B. P.D. Greger, and J.R. Rosier. 2009. Regional and seasonal diet of the western burrowing owl in south central Nevada. Western North American Naturalist 69:1-8.

Hall, D.B., D.C. Anderson, P.D. Greger, W.K. Ostler, and D.J. Hansen. 2013. Ecological Monitoring and Compliance Program 2012 Report. DOE/NV/25946--1776. National Security Technologies, LLC, Ecological Services, July 2013. Las Vegas, NV.

Hall, D.B. and P.D. Greger. 2014. Documenting western burrowing owl reproduction and activity patterns with motion-activated cameras. Western Birds 45:313-323.

Hall, D.B., W.K. Ostler, D.C. Anderson, and P.D. Greger. 2016. Ecological Monitoring and Compliance Program 2015 Report. DOE/NV/25946--2887. National Security Technologies, LLC, Ecological Services, July 2016. Las Vegas, NV.

Hall, D.B., W.K. Ostler, and J.A. Perry. 2017. Ecological Monitoring and Compliance Program 2016 Report. DOE/NV/25946--3317. National Security Technologies, LLC, Ecological Services, September 2017. Las Vegas, NV.

Hall, D.B. and J.A. Perry. 2019. Ecological Monitoring and Compliance Program 2018 Report. DOE/NV/03624--599. Mission Support and Test Services, LLC, Ecological Services, September 2019. Las Vegas, NV.

Hall, D.B., K.T. Shoemaker, and P.D. Greger. 2019. Western Red-tailed Skink (*Plestiodon gilberti rubricaudatus*) Distribution and Habitat Use in Southern Nevada, USA. Herpotological Conservation and Biology 14:455-469.

Hansen, D J., and W.K. Ostler. 2004. A Survey of Vegetation and Wildland Fire Hazards on the Nevada Test Site. DOE/NV/11718--981. Bechtel Nevada, Ecological Services, Las Vegas, NV.

Hansen, D.J., D.C. Anderson, D.B. Hall, P.D. Greger, and W.K. Ostler. 2010. Ecological Monitoring and Compliance Program 2009 Report. DOE/NV/25946—946. National Security Technologies, LLC, Ecological Services, July 2010. Las Vegas, NV.

Hinrichs, E.N., and E.J. McKay. 1965. Geological Map of the Plutonium Valley Quadrangle, Nye and Lincoln Counties, Nevada. US Geological Survey Geologic Quadrangle map GQ-456, Scale 1:24,000.

Jorgensen, C.D. and C.L. Hayward. 1965. Mammals of the Nevada Test Site. Brigham Young University Science Bulletin. 6(3):1-81.

Mission Support and Test Services, LLC. 2019. Nevada National Security Site Environmental Report 2018. DOE/NV/03624—0612. Las Vegas, NV.

Mission Support and Test Services, LLC. 2020. Nevada National Security Site Environmental Report 2019. DOE/NV/03624—XXXX, In Review. Las Vegas, NV.

Morefield, J.D. 1992. *Frasera pahutensis* Reveal, interim status report. Prepared for Department of Interior, Forest Service, Toiyabe National Forest, Sparks, Nevada by Nevada Natural Heritage Program, Carson City, Nevada.

Mozingo, H.N. and M. Williams. 1980. Threatened and Endangered Plants of Nevada; An Illustrated Manual. U.S. Fish and Wildlife Service and Bureau of Land Management. Portland, OR and Reno, NV.

MSTS, see Mission Support and Test Services, LLC

Mulder, K.P., A.D. Walde, W.I. Boarman, A.P. Woodman, E.K. Latch, and R.C. Fleischer. 2017. No Paternal Genetic Integration in Desert Tortoises (*Gopherus agassizii*) following translocation into an existing population. Biological Conservation 210:318-324.

NAC, see Nevada Administrative Code.

National Oceanic and Atmospheric Administration, Air Resources Laboratory/Special Operations and Research Division, 2013. Nevada Test Site (NTS) Climatological Rain Gauge Network. Available at: http://www.sord.nv.doe.gov/home_climate_rain.htm. North Las Vegas, NV. [Accessed May 15, 2013]

Navarro. 2019. Revegetation Strategy for Disturbed Areas at Clean Slate II and Clean Slate III. N/0002653—058. March 2019, Las Vegas, NV.

Nevada Administrative Code. 2020. Chapter 503 - Hunting, Fishing and Trapping; Miscellaneous Protective Measures. Available at: http://www.leg.state.nv.us/NAC/NAC-503.html Carson City, NV. [Accessed February 10, 2020]

Nevada Native Plant Society. 2019. Status Lists. Maintained at Nevada Natural Heritage Program. Contact at: http://heritage.nv.gov/contact. Carson City, NV. [Accessed October 30, 2019].

Nevada Natural Heritage Program. 2020. At-Risk Plant and Animal Tracking List, January 2020. Maintained by the Nevada Natural Heritage Program. Available at: http://heritage.nv.gov/sites/default/files/library/Track%20List%20Jan%202020.pdf. Carson City, NV. [Accessed on February 10, 2020].

NNHP, see Nevada Natural Heritage Program.

NNPS, see Nevada Native Plant Society.

NOAA, see National Oceanic and Atmospheric Administration.

Ostler, W.K., D.J. Hansen, D.C. Anderson, and D.B. Hall. 2000. Classification of Vegetation on the Nevada Test Site. DOE/NV/11718--477, Bechtel Nevada, Ecological Services, December 6, 2000. Las Vegas, NV.

Peterson, F.F. 1981. "Landforms of the Basin & Range Province Defined for Soil Survey." Technical Bulletin 28, Nevada Agricultural Experiment Station, January 1981. University of Nevada, Reno.

Pike, D.A., A. Dinsmore, T. Crabill, R.B. Smith, and R.A. Seigel. 2005. Short-term effects of handling and permanently marking gopher tortoises (*Gopherus polyphemus*) on recapture rates and behavior. Applied Herpetology 2: 139-147.

Poulson, M. 2017. "Sand Cholla, Tiny, Spiny and Stunning." SegoLily; Newsletter of the Utah Native Plant Society, Winter 2017, Volume 40, Number 1.

Reveal, J.L. 1971. A new *Frasera* from southern Nevada (Gentianaceae). Bulletin of the Torrey Botanical Club. Mar-Apr 1971. Vol. 98, No. 2, pp. 107-108.

Rhoads, W.A. and M.P. Williams. 1977. Status of Endangered and Threatened Plant Species on Nevada Test Site – A Survey Part 1: Endangered Species. Santa Barbara Operations. Goleta, CA.

Rhoads, W.A., S. Cochrane, and M. Williams. 1979. Addendum to Status of Endangered and Threatened Plant Species on Nevada Test Site – A Survey, Parts 1 and 2. Santa Barbara Operations. Goleta, CA.

Saethre, M. B. 1994. "Trends in Small Mammal Populations on the Nevada Test Site in 1993." DOE/NV/11432-162. In: Status of the Flora and Fauna on the Nevada Test Site, 1993. Hunter, R. B. compiler, pp. 36-123.

Simpson, M.G. and K.E. Hasenstab. 2009. *Cryptantha* of Southern California. Crossosoma 35:1-59.

Steen, D.C., D.B. Hall, P.D. Greger, and C.A. Wills. 1997. Distribution of the Chuckwalla, Western Burrowing Owl, and Six Bat Species on the Nevada Test Site. DOE/NV/11718—149. Bechtel Nevada, Ecological Services, May 1, 1997. Las Vegas, NV.

Tsukamoto, G.K. G. Tanner, K. Beckstrand, L. Gilbertson, C. Mortimore, and J. Himes. 2003. Nevada's Pronghorn Antelope, Ecology, Management, and Conservation (first revision of 1983 original document). Biological Bulletin No. 13. Nevada Division of Wildlife, Reno, NV.

Turner, F.B., K.H. Berry, B.L. Burge, P. Hayden, L. Nicholson, and J. Bickett. 1987. "Population Ecology of the Desert Tortoise at Goffs, San Bernardino County, California." Proceedings of the Desert Tortoise Council 1984 Symposium, pp. 68-82.

USDA, see U.S. Department of Agriculture.

U.S. Department of Agriculture, Natural Resource Conservation Service, 2020. The PLANTS Database (http://plants.usda.gov, March 17, 2020). National Plant Data Center, Baton Rouge, LA.

U.S. Department of Energy Order DOE O 231.1B, "Environment, Safety, and Health Reporting." November 28, 2012.

U.S. Department of Energy, Nevada Operations Office. 1996. Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada. Volume 1, Chapters 1–9, DOE/EIS--0243, August 1996. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1998. Nevada Test Site Resource Management Plan. DOE/NV--518, December 1998. Las Vegas, NV.

U.S. Executive Order EO 13112, "Invasive Species." February 3, 1999.

U.S. Executive Order EO 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds." January 10, 2001.

U.S. Fish and Wildlife Service. 1996. Final Programmatic Biological Opinion for Nevada Test Site Activities. File No. 1-5-96-F-33, August 22, 1996. Reno, NV.

U.S. Fish and Wildlife Service. 2009. Final Programmatic Biological Opinion for Implementation of Actions on the Nevada Test Site, Nye County Nevada. File No. 84320-2008-F-0416 and 84320-2008-B-0015. February 12, 2009. Las Vegas, NV.

U.S. Fish and Wildlife Service. 2019-1. News Release: Iconic Joshua Tree Does Not Require Protection Under the Endangered Species Act. August 14, 2019. Carlsbad Fish and Wildlife Office, Carlsbad, CA.

U.S. Fish and Wildlife Service. 2019-2. Programmatic Biological Opinion. File No. 08ENVS00-2019-F-0073. August 27, 2019. Las Vegas, NV.

U.S. Fish and Wildlife Service. 2020. Endangered Species Program Home Page. Maintained at: http://www.fws.gov/endangered. [Accessed February 10, 2020]

Wills, C.A., and W.K. Ostler. 2001. Ecology of the Nevada Test Site: An Annotated Bibliography, with Narrative Summary, Keyword Index, and Species Lists. DOE/NV/11718--594, Bechtel Nevada, Ecological Services, September 2001. Las Vegas, NV.

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